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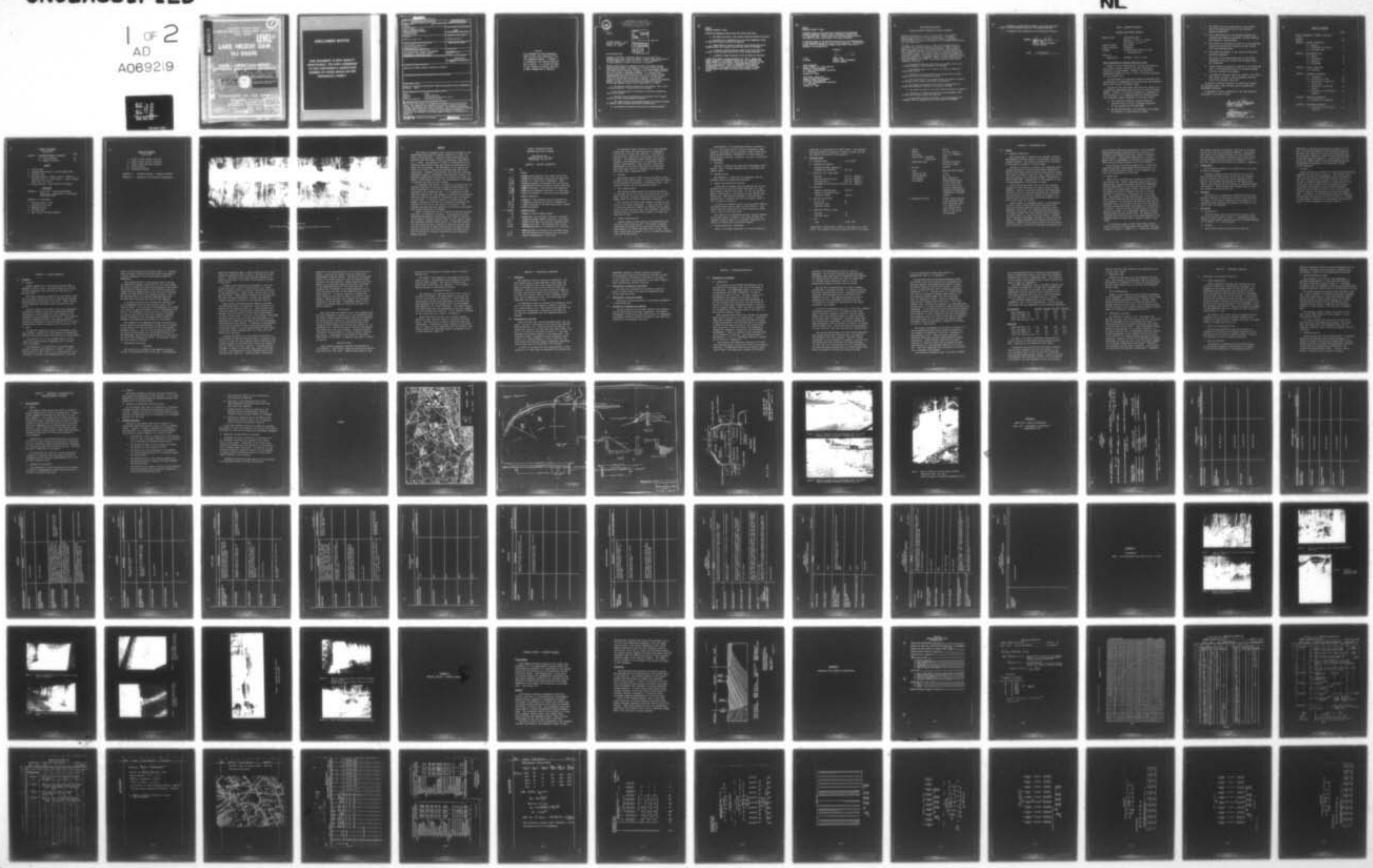

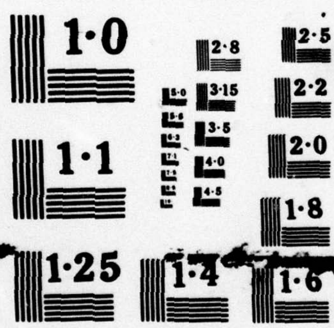

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RARITAN RIVER BASIN
AMBROSE BROOK, MIDDLESEX COUNTY
NEW JERSEY

LEVEL II

LAKE NELSON DAM

NJ 00376

6 PHASE 1 INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM.

Lake Nelson Dam (NJ 00376). Raritan River Basin, Ambrose Brook, Middlesex County, New Jersey. Phase 1 Inspection Report.

9 Final report.,

10 Robert J. /Jenny

DACW61-78-C-0124

15

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Riprap	National Dam Inspection Act Report
Structural Analysis	Lake Nelson Dam, N.J.

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This report cites results of a technical investigation as to the dam's adequacy. The inspection and evaluation of the dam is as prescribed by the National Dam Inspection Act, Public Law 92-367. The technical investigation includes visual inspection, review of available design and construction records, and preliminary structural and hydraulic and hydrologic calculations, as applicable. An assessment of the dam's general condition is included in the report.

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IN REPLY REFER TO

NAPEN-D

7 MAY 1979

Honorable Brendan T. Byrne
Governor of New Jersey
Trenton, NJ 08621

Dear Governor Byrne:

Inclosed is the Phase I Inspection Report for Lake Nelson Dam in Middlesex County, New Jersey which has been prepared under authorization of the Dam Inspection Act, Public Law 92-367. A brief assessment of the dam's condition is given in the front of the report.

Based on visual inspection, available records, calculations and past operational performance, Lake Nelson Dam, initially listed as a high hazard potential structure but reduced to a low hazard potential structure as a result of this inspection, is judged to be in poor overall condition. Also, the spillway is considered inadequate, as 17 percent of the 100 year design flood would overtop the dam. The low hazard potential classification means that in the event of failure of the dam, no loss of life and only minimal economic loss is expected. For the same reasons no further studies or increase of spillway capacity are recommended. However, in order to maintain the structural integrity of the dam, the following remedial actions could be undertaken by the owner:

a. The reservoir should be lowered below the spillway crest so that a thorough inspection of the spillway can be performed.

b. The downstream edge of the spillway sill should be repaired at areas showing erosion.

c. The base of the two buttresses at the northern end of the downstream face of the spillway should be repaired.

d. The eroded portion of the spillway beneath the concrete cap should be repaired, and the concrete cap should be reconstructed.

e. Any erosion of the apron at the toe of the spillway should be

repaired and undermined areas filled with concrete and stone.

f. The cracks and spalls in the concrete wing walls should be repaired.

g. The gully on the downstream face of the south embankment should be filled with suitable material and compacted.

h. Riprap should be placed at sections on the upstream face of the embankment where the original riprap has been removed or dislodged.

i. A permanent extension should be added to the outlet pipe valve so that it can be operated from the top of the adjacent wing wall.

j. A program of annual inspection of the dam should be initiated.

A copy of the report is being furnished to Mr. Dirk C. Hofman, New Jersey Department of Environmental Protection, the designated State Office contact for this program. Within five days of the date of this letter, a copy will also be sent to Congressman Edward Patton of the Fifteenth District. Under the provision of the Freedom of Information Act, the inspection report will be subject to release by this office, upon request, five days after the date of this letter.

NAPEN-D
Honorable Brendan T. Byrne

Additional copies of this report may be obtained from the National Technical Information Services (NTIS), Springfield, Virginia 22161 at a reasonable cost. Please allow four to six weeks from the date of this letter for NTIS to have copies of the report available.

An important aspect of the Dam Safety Program will be the implementation of the recommendations made as a result of the inspection. We accordingly request that we be advised of proposed actions taken by the State to implement our recommendations.

Sincerely,

JAMES G. TON
Colonel, Corps of Engineers
District Engineer

1 Incl
As stated

Copies furnished:
Dirk C. Hofman, P.E., Deputy Director
Division of Water Resources
N. J. Dept. of Environmental Protection
P. O. Box CN029
Trenton, NJ 08625

John O'Dowd, Acting Chief
Bureau of Flood Plain Management
Division of Water Resources
N. J. Dept. of Environmental Protection
P. O. Box CN029
Trenton, NJ 08625

LAKE NELSON DAM (NJ00376)

CORPS OF ENGINEERS ASSESSMENT OF GENERAL CONDITIONS

This dam was inspected on 5 and 21 December 1978 by Jenny-Leedshill Engineers under contract to the State of New Jersey. The State, under agreement with the U. S. Army Engineer District, Philadelphia, had this inspection performed in accordance with the National Dam Inspection Act, Public Law 92-367.

Lake Nelson Dam, initially listed as a high hazard potential structure but reduced to a low hazard potential structure as a result of this inspection, is judged to be in poor overall condition. Also, the spillway is considered inadequate, as 17 percent of the 100 year design flood would overtop the dam. The low hazard potential classification means that in the event of failure of the dam, no loss of life and only minimal economic loss is expected. For the same reasons no further studies or increase of spillway capacity are recommended. However, in order to maintain the structural integrity of the dam, the following remedial actions could be undertaken by the owner:

a. The reservoir should be lowered below the spillway crest so that a thorough inspection of the spillway can be performed.

b. The downstream edge of the spillway sill should be repaired at areas showing erosion.

c. The base of the two buttresses at the northern end of the downstream face of the spillway should be repaired.

d. The eroded portion of the spillway beneath the concrete cap should be repaired, and the concrete cap should be reconstructed.

e. Any erosion of the apron at the toe of the spillway should be repaired and undermined areas filled with concrete and stone.

f. The cracks and spalls in the concrete wing walls should be repaired.

g. The gully on the downstream face of the south embankment should be filled with suitable material and compacted.

h. Riprap should be placed at sections on the upstream face of the embankment where the original riprap has been removed or dislodged.

i. A permanent extension should be added to the outlet pipe valve so that it can be operated from the top of the adjacent wing wall.

j. A program of annual inspection of the dam should be initiated.

APPROVED: James G. Ton

JAMES G. TON
Colonel, Corps of Engineers
District Engineer

DATE: 7 May 1979

PHASE I INSPECTION REPORT

NATIONAL DAM SAFETY PROGRAM

Name of Dam:	Lake Nelson Dam Federal I.D. No. NJ 00376 New Jersey I.D. No. 97
State Located:	New Jersey
County Located:	Middlesex
Stream:	Ambrose Brook, Branch of the Raritan River
Dates of Inspection:	December 6 and 21, 1978

Brief Assessment of General Condition of Dam

Based on visual observations, the dam and spillway are in poor overall condition and their structural integrity is questionable. However, the potential downstream hazards are low, so that it has been assessed as a low hazard dam.

The hydrologic and hydraulic analysis indicates that the spillway is inadequate and can only pass approximately 16% of the 100-year frequency flood.

Failure of the Lake Nelson Dam would not result in a significant downstream hazard to loss of life or propety damage. However, in order to maintain the integrity of the structure, it is suggested that the owners initiate the following remedial measures in the near future:

1. The reservoir should be lowered below the spillway crest so that a thorough inspection of the spillway can be performed.
2. The downstream edge of the spillway sill should be repaired at areas showing erosion.

3. The base of the two buttresses at the northern end of the downstream face of the spillway should be repaired.

4. The eroded portion of the spillway beneath the concrete cap should be repaired, and the concrete cap should be reconstructed.

5. Any erosion of the apron at the toe of the spillway should be repaired and undermined areas filled with concrete and stone.

6. The cracks and spalls in the concrete wing walls should be repaired.

7. The gully on the downstream face of the south embankment should be filled with suitable earth and compacted.

8. Riprap should be placed at sections at the upstream face of the embankment where the original riprap has been removed or dislodged.

9. A permanent extension should be added to the outlet pipe valve so that it can be operated from the top of the adjacent wing wall.

A long term solution would be to remove and replace the spillway with a new structure and to restore the embankment sections.

A program of annual inspection of the dam should be initiated in the near future.

Frank L. Panuzio

Frank L. Panuzio, P.E.
Project Engineer

R J Jenny

Robert J. Jenny, P.E.
Project Director
New Jersey License No. 9878

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LA

View of dam looking
(D

2

LSON DAM

tream from north bank of reservoir.
, 1978)

PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D. C. 20314. The purpose of a Phase I Investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through continued care and inspection can there be any chance that unsafe conditions be detected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the Spillway Test flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. The test flood provides a measure of relative spillway capacity and serves as an aide in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

PHASE I INSPECTION REPORT

NATIONAL DAM SAFETY PROGRAM

LAKE NELSON DAM
Federal I.D. No. NJ 00376
New Jersey I.D. No. 97

SECTION 1: PROJECT INFORMATION

1.1 Gener[illegible]al

a. A[illegible]uthority

T[illegible]he National Dam Inspection Act, Public Law 92-367, 1972, [illegible] provides for the National Inventory and Inspection Progr[illegible]am by the U. S. Army Corps of Engineers. This repor[illegible]t has been prepared in accordance with this authority, [illegible] through contract between the State of New Jersey and Jenny[illegible]-Leadhill Engineers. The State of New Jersey has also [illegible]entered into an agreement with the U. S. Army Engineer [illegible] District, Philadelphia, to have this work performed.

b. P[illegible]urpose of Inspection

T[illegible]he purpose of this inspection was to evaluate the gener[illegible]al structural integrity and hydraulic adequacy of the d[illegible]am, and to determine if the dam constitutes a hazard to hu[illegible]man life or property.

1.2 Descr[illegible]iption of Project

a. D[illegible]escription of Dam and Appurtenances

L[illegible]ake Nelson Dam is an earthfill dam with a concrete core [illegible]wall and clay puddle backfill adjacent to the core wall. [illegible] The dam is 487 feet long and has a maximum height of ap[illegible]proximately 10.5 feet. The slope of both the upstrea[illegible]m and downstream face is 2 horizontal on 1 vertical.

A [illegible] masonry spillway is located in the northern third of th[illegible]e dam. The length of the spillway weir is 83 feet and t[illegible]he crest is approximately 3 feet wide.

The emergency outlet consists of an 8-inch diameter outlet pipe, which has been installed to supplement a sluice gate to drain the reservoir. The outlet is controlled by a gate valve on the right side of the spillway. The presently unused wooden sluice gate is located at the upstream end of a rectangular outlet conduit, approximately 5 feet high and 2 feet wide, discharging at the lower right side of the spillway. The sluice gate control is located on the upstream end of the right (north) wing wall.

b. Location

Lake Nelson Dam is located across the Ambrose Brook, a branch of the Raritan River, in north central New Jersey, in the borough of Piscataway, in Middlesex County. The regional vicinity map is presented on Plate 1.

c. Size Classification

The maximum storage capacity of Lake Nelson Dam is 85 acre-feet at the top of dam, and the dam is 10.5 feet high; therefore, the size classification of the dam is <u>small</u>, based on the Corps of Engineers Guidelines.

The criteria for size classification of dams are set forth in the Corps' Guidelines. A small size dam is one in which the reservoir capacity is greater than or equal to 50 acre-feet and less than 1,000 acre-feet, and/or the maximum height is greater than or equal to 25 feet and less than 40 feet.

d. Hazard Classification

Several houses on both sides of the downstream channel were visable from the dam. The closest residence downstream is located on the north bank of the channel approximately 100 yards downstream from the dam. However, these dwellings appear to be at an elevation greater than the spillway crest.

Investigation of the downstream channel and study of the U. S. Geological Survey 7.5-minute topographic maps indicate that there are no buildings or major roads which would be significantly influenced by a flood resulting from failure of the dam. Therefore, the dam is classified as <u>low hazard</u>.

e. Ownership

The dam is owned by the Lake Nelson Improvement Association, Inc., 29 North Lakeside Drive, Piscataway, New Jersey, 08854.

f. Purpose of Dam

The reservoir is used only for recreation and its aesthetic value to neighboring residents.

g. Design and Construction History

A small dam of unknown size and construction was reportedly built on the John Nelson Farm about 100 years ago to make a 200-foot long pond. In 1913, an earthfill dam was constructed in the location of the present Lake Nelson dam. This dam was breached in 1926 and reconstructed with a concrete core wall and raised 2 feet in 1927, as shown in Plate 2.

An eight-inch diameter outlet pipe was placed beneath the wooden sluice gate in about the late 1960's. This outlet pipe was installed to be used to drain the reservoir in lieu of the sluice gate.

The remains of an emergency spillway located adjacent to the left (south) abutment of the main spillway was observed; however there is no available information regarding its design and construction history.

h. Normal Operational Procedures

There is no normal regulation, nor is the reservoir

drawn down in anticipation of heavy runoff. The reservoir has been drained on occasions in order to repair the dam and inspect the bottom of the reservoir.

1.3 Pertinent Data

a. Drainage Areas — 5 sq. miles

b. Discharge at Damsite

- Ungated spillway capacity at maximum pool elevation — 610 cfs

c. Elevation (ft. above MSL)*

·Top dam	58.5 ft. (Approx.)
·Top spillway wing walls	60.0 ft. (Approx.)
·Spillway crest	56.5 ft. (Approx.)
·Streambed at centerline of dam	48.0 ft. (Approx.)

d. Reservoir

·Length of maximum pool	4000 ft.
·Length of recreation pool (Spillway crest)	2600 ft.

e. Storage (acre-feet)

·Top of dam	85
·Recreation pool (Spillway crest)	40

f. Reservoir Surface (acres)

·Top dam	30
·Spillway crest	14

g. Dam

·Type	Earth fill

*Elevations on design plans (Plate 2) are based on a local datum. MSL elevation has been estimated from U.S.G.S. maps.

•Length	487 ft.
•Height	10.5 ft. (Approx.)
•Top width	3 to 6 ft. (Approx.)
•Side slopes - upstream	2H:1V
- downstream	2H:1V
•Impervious core	Concrete core wall with clay puddle backfill

h. Spillway

•Type	Masonry, free overfall
•Length of weir	83 ft.
•Crest elevation	56.5 ft.
•U/S channel	None (reservoir)
•D/S channel	Narrow masonry apron at toe of spillway. Stilling basin with revetted embankments immediately downstream discharging to natural channel.

i. Regulating Outlets — Wooden sluice gate and 8-inch diameter pipe; both discharge into a 5 ft. high by 2 ft. wide conduit which exits at the toe of the spillway.

SECTION 2: ENGINEERING DATA

2.1 Design

a. Geologic Conditions

Lake Nelson Dam is located in the Piedmont Lowlands physiographic province south of the Wisconsin age glacier terminal moraine. The regional geology of this province is discussed in Appendix C to this report.

The dam is situated on a broad, flat, dissected plain composed primarily of stratified material deposited by glacial melt-waters during the most recent glacial period. This glacial outwash is typically silt, sandy silt, silty sand and gravelly sand with some cobbles, desposited in well defined beds. Permeability of this material is fair to good depending on the percent of fines.

Within the stream banks, and in the flat lowlands adjacent to them, are soils and recent alluvial stream deposits. This soil typically takes on the characteristics of the soil or alluvium from which they originated. At this project the alluvium appears to be mainly silt and sand with some clay and a significant amount of organic matter near the surface.

Report Number 10, Middlesex County, of the Engineering Soil Survey of New Jersey series indicates that relatively shallow bedrock could be expected on both abutments of the dam. The classification presented by the report assumes that shale bedrock could be expected at depths from 2 to 6 feet below the surface. However, due to extensive development adjacent to the dam and the lakes, no bedrock exposures were observed during the inspection. Bedrock in the area is known to be the Brunswick formation, a Triassic age red-brown soft shale with

minor sandstone beds which dips gently to the northwest. Construction reports indicate that the core wall is founded on the Brunswick formation, which is described as "red shale". From surface observations, it would appear that the embankment of this dam is constructed of soils and rock derived primarily from this formation.

Since the dam lies within Seismic Zone 1, only minor damage from distant earthquakes should be expected. No active faults are known to exist in the immediate vicinity nor surrounding area of the dam.

b. Design Data

There are no available data regarding the design of the original dam. Details regarding construction of the existing dam, repairing breaches through the embankment and the construction of the concrete and clay core wall are shown on a drawing dated October, 1926 (Plate 2). The design called for a concrete core wall to be constructed to an elevation 2 feet below the top of the dam. The designer of these modifications is not known. This drawing indicates that the spillway wing walls were to be raised to 3.5 feet above the spillway crest and the embankment was to be raised to the top of the wing walls and have upstream and downstream slopes of 2 horizontal to 1 vertical. Plate 2 has very limited details of the main spillway and there is no information regarding the emergency spillway nor the outlet works. The design drawing indicates that earth fill was to be placed adjacent to the upstream side of the spillway to within 6 inches of the crest.

An engineering report titled "Lake Nelson Environmental Protection and Improvement" dated August 1971 was prepared by Robert J. Haefeli, P.E., Consulting Engineers.

This report discusses the physical condition of the reservoir at that time and alternative methods of improvement. This report also contains contours and cross sections of the lake depth and sediment thickness, and storage curves for the original lake and surface of sediments in 1959 and 1971. Selected illustrations are included in Appendix D.

2.2 Construction

No information regarding the construction of the original dam is available.

Inspection reports of the construction of the core wall indicate that the section of the wall from approximately 150 feet from the left (south) abutment to the spillway was extended approximately 4 feet deeper than shown on the plans due to the presence of unsuitable foundation material. These reports also indicate that the wall was founded on red shale and clay.

2.3 Operation

The reservoir is essentially unregulated and the only operation consists of occasional draining of the reservoir for repair of the dam or inspection of the reservoir. No engineering data regarding the operation or design of the outlet works are available.

2.4 Evaluation

a. Availability

Available design data for the dam are limited to the plans and sections shown in Plate 2. Engineering reports related to more recent reservoir siltation problems prepared by R. Haefeli, P.E., are available.

b. Adequacy

The available design and construction data are

inadequate to evaluate the structural stability of the dam. Calculations relating to the structural design of the dam or the stability of the as-built structure are not available. Nothing is known of construction methods or as-built material properties. Design plans are old and do not reflect present conditions regarding details of embankment configuration and locations of appurtenant structures.

c. Validity

Visual inspection indicates that the existing dam differs somewhat from that shown in Plate 2. This drawing indicates that the top of the embankment was to be raised to the top of the spillway wing walls; however, the top of the dam is presently approximately 1.5 feet below the top of the wing walls, possibly due to subsequent erosion. The present configuration of the spillway discharge channel is not as shown on Plate 2, and a concrete wall has been added at the upstream side of the north embankment. In addition, the spillway buttresses and apron and the emergency spillway are not shown on Plate 2. A sketch of the present configuration of the general spillway area based on visual inspection is shown on Plate 3.

SECTION 3: VISUAL INSPECTION

3.1 Findings

a. General

Visual inspections of Lake Nelson Dam were made on December 6 and 21, 1978. The water surface at the time of both inspections was less than one inch above the spillway crest.

The visual inspection revealed that the masonry spillway is severely eroded and there is significant cracking and spalling of the concrete wing walls. Severe erosion of the embankment and local riprap failures were also noted.

Detailed inspection was made of the dam, appurtenant structures, reservoir area and the downstream channel. Descriptions of the findings of these inspections are summarized in the paragraphs which follow. The checklist of visual inspection items is included in Appendix A. Geologic and foundation conditions observed at the time of inspection are noted in greater detail in Section 2.1-a.

b. Dam

The dam was inspected for signs of settlement, seepage, erosion, cracking, and other evidence of undesirable behavior which might affect the stability of the structure.

The dam crest is, on the average, about 1-½ feet below its design elevation apparently due to erosion and/or settlement.

The embankment is covered with a relatively dense growth of mature trees (Photos 1, 2 and 3). A gully, approximately 20 feet long by 3 to 5 feet wide and 1 to 2 feet deep, was noted on the downstream face of the dam

about 125 feet south of the spillway (Photo 1). Contours shown on Plate 2 indicate that this gully is upstream of a natural depression in the ground surface below the embankment.

The visible portion of the upstream face of the dam is covered with riprap, consisting of 6- to 9-inch stones. The face is covered with grass and disrupted by tree roots. Two sections of riprap about 20 feet wide have been dislodged from the upstream face of the dam; one 30 feet and another 175 feet south of the spillway (Photos 2 and 3). The upstream face of the dam was submerged below the spillway crest elevation and could not be inspected.

A concrete retaining wall protects the upstream side of the embankment north of the spillway (Plate 3 and Overview Photo). This section of the embankment is covered with trees and grass and appears to be in satisfactory condition. The embankment in this area is in the backyard of a house, the owner of which (Mr. Komanski) reported several instances of dam overtopping which flooded his basement and endangered the foundation of his house.

The remains of the emergency spillway consisting of a broken concrete slab approximately 20 feet long is located on the crest of the dam just south of the left spillway abutment (Photo 3). The top of this broken concrete slab is several inches higher than the average elevation of the embankment crest which is approximately 1.5 feet below the top of the concrete wing walls. The emergency spillway thus serves no function.

c. Appurtenant Structures

Spillway

The spillway is a mortared stone masonry structure located in the northern third of the dam. The downstream

edge of the spillway crest is badly eroded and has a very irregular outline as shown in Photo 4 and Photos A and B, Plate 4. The width of the crest has been reduced up to about one foot due to the erosion and plucking of stones in this area.

A breach in the spillway crest adjacent to the left (south) wing wall, about 10 feet long and 2 to 3 feet deep, has been filled with concrete; the surface of which is now approximately 3 inches higher than the rest of the spillway crest. Rubble masonry beneath this concrete cap has been partially undermined, and water was observed leaking through this section of the spillway (Photo 5).

Water flowing over the spillway generally obscured the downstream face of the spillway, thus restricting inspection of the spillway (Photo 6). Three concrete and stone buttresses are located along the downstream face of the dam, one in the center and the others approximately 30 feet on either side. The face of the spillway, buttresses and stone apron at the toe of the spillway appear to be significantly eroded and the bases of the two northernmost buttresses have been removed. In addition, water appeared to be flowing through the face of the spillway between the masonry stones in an area approximately 30 feet north of the left (south) abutment and 2 to 3 feet below the crest of the spillway.

Cracking and spalling of the concrete wing walls at each abutment of the spillway was noted. A vertical crack 1/8 to 1/4 inch wide, plus spalling of the concrete on the surface adjacent to the crack were noted in the center of the left (south) wing wall (Photo 7). Cracking and displacement of about 1/2 inch were also noted in the left wing wall just downstream of the downstream edge of the spillway crest (Photo 8). Nearly vertical cracks were

observed in the upstream section of the right wing wall; however, there did not appear to be any significant displacement along the cracks. Spalling of the upstream section of the right wing wall near the spillway crest elevation was also observed. Severe spalling along what appear to be horizontal construction joints is present on the downstream section of the right wing wall. A concrete sill is present at the downstream base of the right wing wall and part of the wooden form is still in place (Photo 9). It was not possible to inspect the apron because of the flow of water, but erosion is suspected, a condition which could imperil the structural stability of the spillway. Photographs taken in 1973 showing the spillway when the reservoir was empty are shown on Plate 4.

Outlet Works

The sluice gate and intake of the 8 inch diameter outlet pipe, described in Section 1.2-a were submerged during the visual inspection and therefore could not be observed. The outlet of the 5 feet by 2 feet rectangular conduit on the downstream face of the spillway was partly obscured by water flowing over the spillway (Photo 10). An automobile tire, cobble size stones and minor wood debris were observed in the outlet conduit. Water was flowing through the outlet conduit at a rate of about 15 gallons per minute. A photograph of the intake to the outlet works taken in 1973 when the reservoir was empty, is shown on Plate 5.

Reservoir Area

Single family residences surround the perimeter of the reservoir. The adjacent slopes are gentle and covered with lawns and a few trees. Ambrose Creek enters at the

east end of the reservoir and passes under a bridge at Metlars Lane.

The water in the reservoir is extremely turbid and brown in color. Considerable bottom sediment is visible from the water surface. The lake is obviously very shallow due to the heavy silt deposits. No noticeable debris was seen on the reservoir surface.

Downstream Channel

The discharge over the spillway falls into a pool at the base of the weir. The water depth in the pool was 0.5 to 1 foot during the inspection. A few of the cut stones which line the south embankment of the pool have been dislodged, but the sandbag lining of the southern edge appears to be in good condition. The rubble masonry wall which lines the north embankment of the pool appears to be in satisfactory condition. A soil deposit is present at the toe of this wall (Plate 3 and Photo 9).

Water flows from the pool into a natural channel generally along the north side of a 250-foot wide flood plain. The flood plain is heavily wooded and has thick undergrowth. A steel foot bridge, parallel to the spillway, is located 35 feet downstream from the spillway. This bridge crosses the downstream channel and appears to be in good condition (Photo 11).

SECTION 4: OPERATIONAL PROCEDURES

4.1 Procedures

The reservoir level is generally unregulated. The sluice gates have not been operated in many years and the 8 inch diameter outlet pipe installed beneath the gates is now used in lieu of the gates to drain the reservoir. The reservoir has been lowered occasionally to repair the dam and inspect the lake bottom. The outlet pipe valve control does not have a permanent extension, and is operated by a key. The outlet pipe was reportedly last operated in 1973.

An engineering report to evaluate the problem of siltation of Lake Nelson was prepared by Robert S. Haefeli, P.E., dated August, 1971. This report concluded that the accumulation of sediments threatens the existence of the lake and recommended that the sediments should be removed.

4.2 Maintenance of the Dam

There has been very little maintenance work over the years. The dam is maintained by the Lake Nelson Improvement Association, Inc. Maintenance and dam repairs, including the repair of the dam crest and right (north) wing wall of the spillway described in Section 3, have been performed by volunteer members of the Association. The inspection report, prepared by Frank and Haefeli Associates, P.A., dated November 16, 1973, notes that the foot bridge and discharge channel immediately downstream from the spillway are maintained by the Township.

A breach of the spillway crest approximately 10 feet long and 2 to 3 feet deep was replaced with concrete and

embankment repairs of unknown location and extent were performed following overtopping of the dam in 1968. In 1973 concrete was placed at the base of the right (north) wing wall, just downstream of the outlet conduit, where undercutting had been observed.

4.3 Maintenance of Operating Facilities

The owner has installed an alternative reservoir drain in recent years, but there has apparently been little other work done.

4.4 Description of Warning Systems

There are no warning systems or contingency procedures at Lake Nelson Dam.

4.5 Evaluation of Operational Adequacy

The poor condition of the dam indicates that maintenance of the structure has been inadequate. The present arrangement of the outlet pipe valve control is inadequate. A permanent extension should be attached to the valve and extend up to the adjacent wing wall.

SECTION 5: HYDRAULIC/HYDROLOGIC

5.1 Evaluation of features

a. Design Data

The capacity of Lake Nelson Dam Reservoir is 40 acre-feet at the spillway crest and 85 acre-feet at the dam crest. The embankment height is 10.5 feet. In accordance with Corps' guidelines, the dam is classified as small in size. The small capacity of the reservoir and absence of buildings or major roads within the potential flood area downstream of the dam indicates that failure of the dam should not result in a significant downstream hazard to loss of life or property damage. Thus, the dam is classified as low hazard and the Spillway Design Flood (SDF) is the 100-year frequency flood.

Data obtained from State files indicate the drainage basin area of the Dam is 5.0 square miles. Elevations range from a maximum of about 100 feet mean sea level along the perimeter of the drainage basin to a minimum of about 60 feet mean sea level in the valley floor. Over 50 percent of the land within the watershed is occupied by commercial, industrial, and residential developments. About 0.5 percent of the watershed area is the reservoir of the dam. The drainage basin is delineated on a U.S.G.S. topographic map and is presented on Plate D-1, Appendix D.

The hydraulic and hydrologic features of the dam were evaluated using criteria set forth in the Corps of Engineers' "Recommended Guidelines for Safety Inspection of Dams", and additional guidance and criteria

provided by the Philadelphia District, Corps of Engineers. The 100-year frequency precipitation was calculated using NOAA Technical Memorandum NWS HYDRO-35 for precipitation durations less than 60 minutes and U.S. Weather Bureau Technical Paper No. 40 for precipitation duration greater than 60 minutes.

The SDF was calculated using the Corps' computer program HEC-1, Dam Break Version. In computing the SDF the Corps requested that the Soil Conservation Service triangular unit hydrograph with curvilinear transformation be used. The computer program was used to calculate this unit hydrograph from the basin lag. A lag time of 2.0 hours was calculated for the basin and used in the program.

An initial infiltration loss of 0.5 inch and a constant infiltration loss rate of 0.05 inches per hour were used in the HEC-1 program to give the rainfall excess. These values were selected because a large percentage of the basin area is developed. Using the excess rainfall and the unit hydrograph, the program computed the peak discharges of the 10 percent, 25 percent, 50 percent and 100 percent SDF. These discharges are approximately 435 cfs, 1090 cfs, 2180 cfs, and 4350 cfs, respectively.

The various percentages of the SDF inflow hydrograph were routed through the reservoir using the Modified Puls Method by the HEC-1 program. The peak outflow discharges of the 10 percent, 25 percent, 50 percent and 100 percent SDF were calculated to be approximately 370 cfs, 1070 cfs, 2140 cfs and 4270 cfs, respectively. The flood routings indicate that all floods greater than about 16 percent of the SDF will overtop the dam.

A plot of percent SDF versus peak outflow is presented as Plate D-2 in Appendix D.

The spillway and overtop stage-discharge rating curve used in the flood routings was calculated using the weir equation and assuming free overflow across the entire length of the dam and spillway. The spillway is a 3-feet wide weir with a reported discharge coefficient of 2.6. The dam crest is a round-crested weir with an estimated discharge coefficient of 2.6. The reservoir stage-storage curve was determined from U.S. Geological Survey 7.5-minute topographic maps and data obtained from State files. This stage-storage curve, adjusted for sediments, was extended above the dam crest to include surcharge storage during peak flood discharges. In the reservoir routing computations possible discharges through the outlet works were excluded because their capacity is small compared to the SDF and because of the possibility that the outlet valves may be inoperable. The stage-storage and the spillway and overtop stage-discharge curves are presented in Appendix D as Plates D-3 and D-4, respectively.

The various percentages of the SDF were routed 2.8 miles downstream through three successive reaches to the township of Possumtown, which has a population of approximately 36,000. These routings were made to determine downstream flooding characteristics without dam failure. These flooding characteristics were compared to those that would result assuming the dam fails because of the inadequate capacity of its spillway. From this comparison the seriousness of the spillway's inadequacy was assessed.

The hydraulic parameters used in the HEC-1 program

for the downstream routing calculations were estimated based on observations made in the field and information obtained from U.S.G.S. topographic maps. The locations of the channel cross-sections used in these routings are shown on page D-8, Appendix D.

The breach parameters used in the HEC-1 analysis are: the breach is trapezoidal in shape with 45-degree side slopes, 410 feet wide at the base, will extend to the approximate original reservoir floor elevation (50.5'), will begin breaching when the dam is first overtopped, and will develop to its maximum size in 2.0 hours.

The flooding characteristic at the township of Possumtown, (Pop. 36,000 approximately), for the various percentages SDF are summarized in the following tabulation:

No Breaching	10% SDF	25% SDF	50% SDF	100% SDF
Peak Discharge, cfs	275	725	1580	3370
Peak Flow Depth, ft.	3.9	5.1	6.6	8.1
Peak Flow Width, ft.	125	255	420	560
Peak Flow Velocity, fps	1.9	2.0	1.8	2.1
Breaching				
Peak Discharge, cfs	275	1080	1930	3570
Peak Flow Depth, ft.	3.9	5.9	6.9	8.3
Peak Flow Width, ft.	125	345	455	610
Peak Flow Velocity, fps	1.9	1.8	1.9	2.0

As shown in the above tabulation, there would be little increase in downstream flooding should the dam fail, during any of the specified flood events.

Information obtained from the dam owners indicates that the only operable drain for the reservoir is an 8-inch diameter pipe through the dam that discharges into the downstream spillway channel. Using the orifice flow equation, and assuming no inflow into the reservoir or tailwater, the time required to drain the reservoir

from the spillway crest elevation was calculated to be a little over 6 days.

b. Experience Data

Records of lake levels are not maintained for this site. The reservoir is unregulated, used for recreation and therefore is generally at or near its spillway level. The dam owners report that the dam has been overtopped several times.

c. Visual Observations

There is a well defined spillway channel downstream of the embankment. Dwellings were observed on both sides of the immediate downstream channel. However, those dwellings appeared to be at an elevation equal to or greater than the spillway crest. The flood plain below the dam contains a fairly dense stand of medium and small trees with significant undergrowth (Photo 11).

d. Overtopping Potential

As indicated in Section 5.1-a, Lake Nelson Dam spillway can pass only 16 percent of the SDF. During the SDF the embankment would be overtopped for about 7.0 hours and would have a maximum overtopping stage about 1.8 feet above the dam crest. These overtopping heights assume the dam remains in its current condition. It is highly probable that the embankment would be breached during overtopping at this duration and the core wall is not expected to provide adequate protection against breaching. However, failure is not expected to increase the potential hazard to loss of life or property damage nor is the dam classified as high hazard. Therefore, in accordance with the Corps' Guidelines, the spillway for Lake Nelson Dam should be classified as Inadequate.

SECTION 6: STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability

a. Visual Observations

Visual inspection indicates that the dam, and the spillway in particular, shows signs of distress. The seepage and the severe erosion of the spillway crest, downstream face and possible undercutting at the toe, plus the cracking of the concrete wing walls jeopardize the structural stability of the spillway. Local erosion noted on the southern slope does not appear to presently be severe enough to affect the structural strength or stability but could cause problems if left unchecked. There has apparently been general erosion and possibly settlement of this embankment which has lowered the crest elevation approximately 1.5 feet.

The intake to the outlet works was submerged during inspection and could not be observed; however, flow through the outlet conduit indicates that there is leakage around or through the outlet pipe.

b. Design and Construction Data

The available design and construction data are inadequate to evaluate the structural stability of the dam since little is known of design criteria, construction methods or as-built material properties.

c. Operating Records

The reservoir is essentially uncontrolled except for occasional draining of the reservoir for repairs to the dam and inspection of the reservoir bottom.

Records of reservoir levels and water withdrawals are not available, and there are few records of operation and maintenance. There is no instrumentation of the dam.

d. Post-Construction Changes

The elevation of the crest of the embankment is presently approximately 1.5 feet lower than shown on the plan for dam modifications (Plate 2). Therefore, it appears that the embankment crest has been significantly eroded and possibly settled since its reconstruction in 1927.

The breach through the spillway crest adjacent to the left (south) abutment was repaired by placing a concrete cap in the eroded section. Water was observed seeping through the face of the spillway beneath the concrete cap and erosion causing partial undermining of the concrete cap has occured. Therefore, the structural stability of this section of the spillway is questionable.

The concrete placed to repair the erosion at the base of the right (north) wing wall appears to be in satisfactory condition.

An 8-inch diameter pipe has been installed to be used in place of the wooden sluice gates. The outlet pipe and sluice gates were submerged during the inspection; therefore, their structural integrity cannot be evaluated.

e. Seismic Stability

Since the area lies within Seismic Zone 1, only minor damage may be expected from distant earthquakes. In general, projects located within Seismic Zone 1 may be assumed to present no hazard from earthquakes, provided static stability conditions are satisfactory and conventional safety margins exist. However, static stability analyses are not presently available.

SECTION 7: ASSESSMENT, RECOMMENDATIONS, PROPOSED REMEDIAL MEASURES

7.1 Dam Assessment

a. Safety

The safety of Lake Nelson Dam cannot be quantitatively analyzed due to lack of available data. However, visual inspection indicates that the dam is in very poor condition. The seepage and the severe erosion of the spillway crest, downstream face and possible undercutting at the toe, plus the cracking of the concrete wing walls jeopardize the structural stability of the spillway. Local erosion noted on the southern slope is not presently severe enough to affect the structural strength or stability but could cause problems if left unchecked.

Observation of the downstream channel from the dam and U.S.G.S. maps indicate that there are no buildings or major roads which would be significantly influenced by a flood resulting from failure of the dam. Therefore, the dam is classified as low hazard.

The hydrologic and hydraulic analyses discussed in Section 5 indicates that the present spillway is inadequate and can pass only approximately 16% of the 100-year frequency flood.

b. Adequacy of Information

The information and data obtained are not adequate to perform a comprehensive, definitive evaluation of the dam's structural stability.

c. Urgency

The visual inspection revealed critical deficiencies that imperil the integrity of the structure. It is recommended that the owners perform the remedial measures discussed below in the near future.

d. Necessity fo Additional Data/Evaluation

At the present time there is insufficient information available to fully evaluate the structural stability of the dam. However, due to the low hazard potential classification, no additional data or evaluations are considered necessary at this time.

7.2 Remedial Measures

Failure of Lake Nelson Dam would not result in a significant downstream hazard to loss of life or property damage. However, in order to maintain the integrity of the structure, it is suggested that the owners perform the following remedial measures in the near future:

1. The reservoir should be lowered below the spillway crest so that a thorough inspection of the spillway can be performed to determine deficiencies.
2. The downstream edge of the spillway sill should be repaired at areas showing erosion.
3. The base of the two buttresses at the northern end of the downstream face of the spillway should be reconstructed.
4. The eroded portion of the spillway beneath the concrete cap should be repaired and the concrete cap reconstructed.
5. The erosion of the apron at the toe of the spillway should be repaired and any possible undermining filled with concrete and stone.

5. The cracks and spalls in the concrete wing walls should be repaired.

6. The gully on the downstream face of the south embankment should be filled with suitable earth and compacted.

7. Riprap should be placed at sections at the upstream face of the embankment where the original riprap has been removed or dislodged.

8. A practical extention should be added to the outlet pipe valve so that it can be operated from the top of the adjacent wing wall.

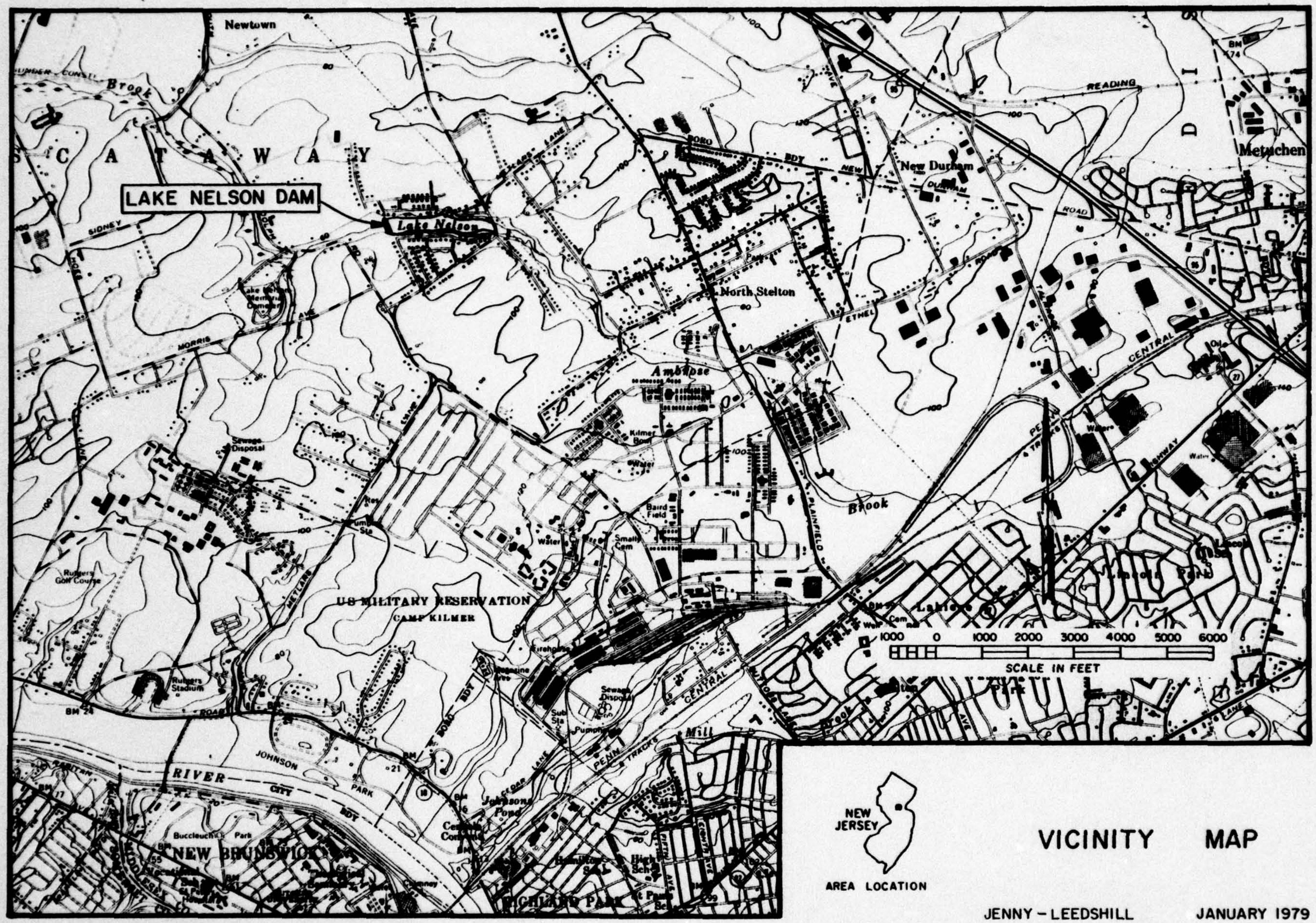
A long term solution would be to remove the spillway and replace it with a new structure or enclose the existing structure in a new one and restore the embankment sections.

b. Operation and Maintenance Procedures

A program of annual inspections of the dam should be initiated, utilizing the standard visual checklist in this report. Inspection of the outlet works should be performed when the reservoir is sufficiently low to observe these facilities. In addition, the dam should be carefully inspected should it be overtopped, in order to detect additional erosion or other detrimental effects on the structure.

A permanent record should be kept of all maintenance and operating events of the dam and reservoir.

PLATES



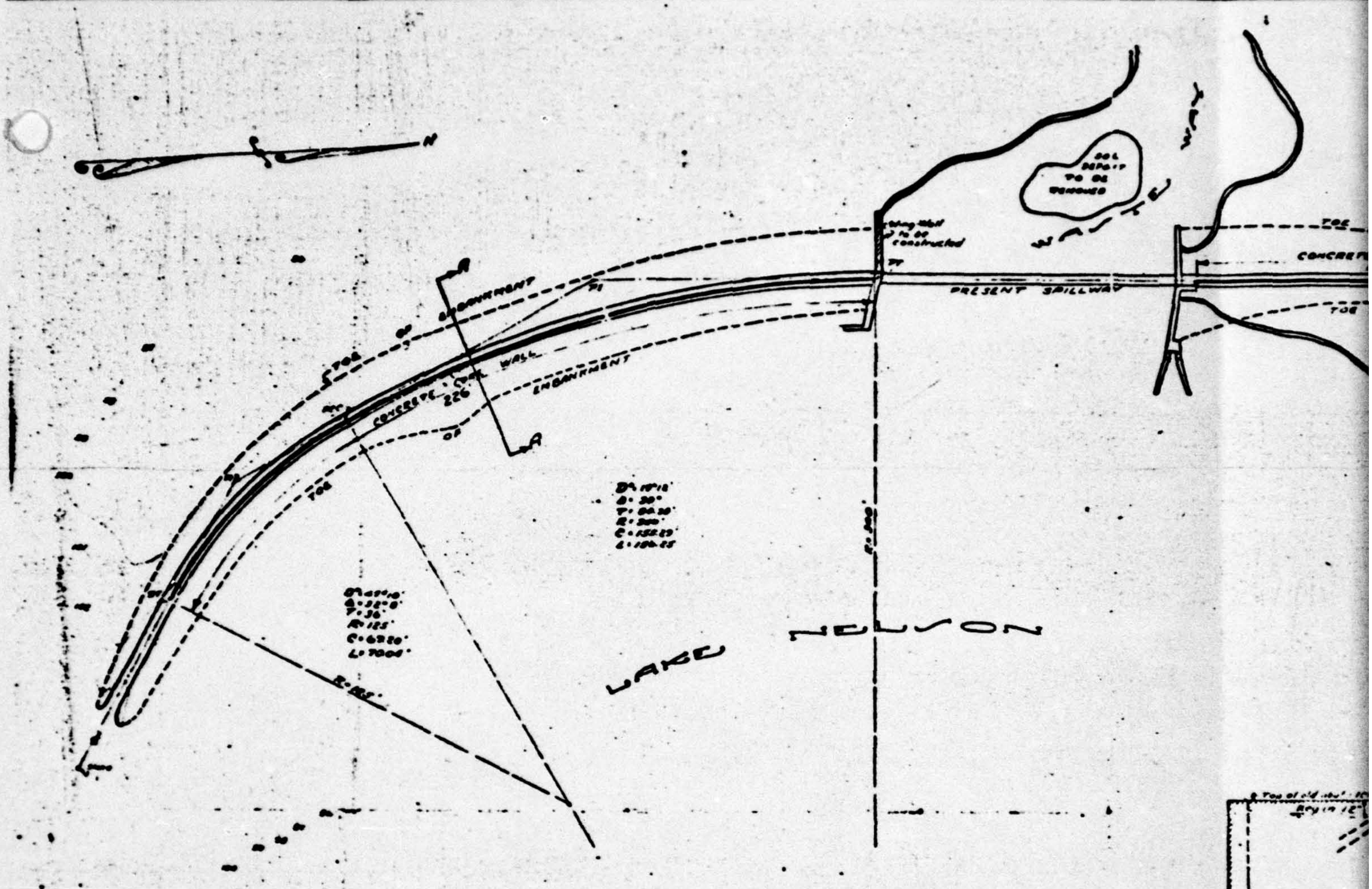
NEW JERSEY

AREA LOCATION

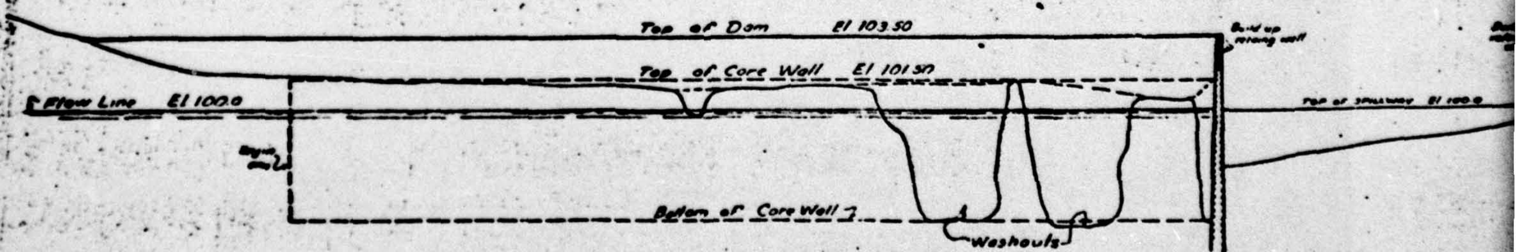
VICINITY MAP

JENNY - LEEDSHILL

JANUARY 1979

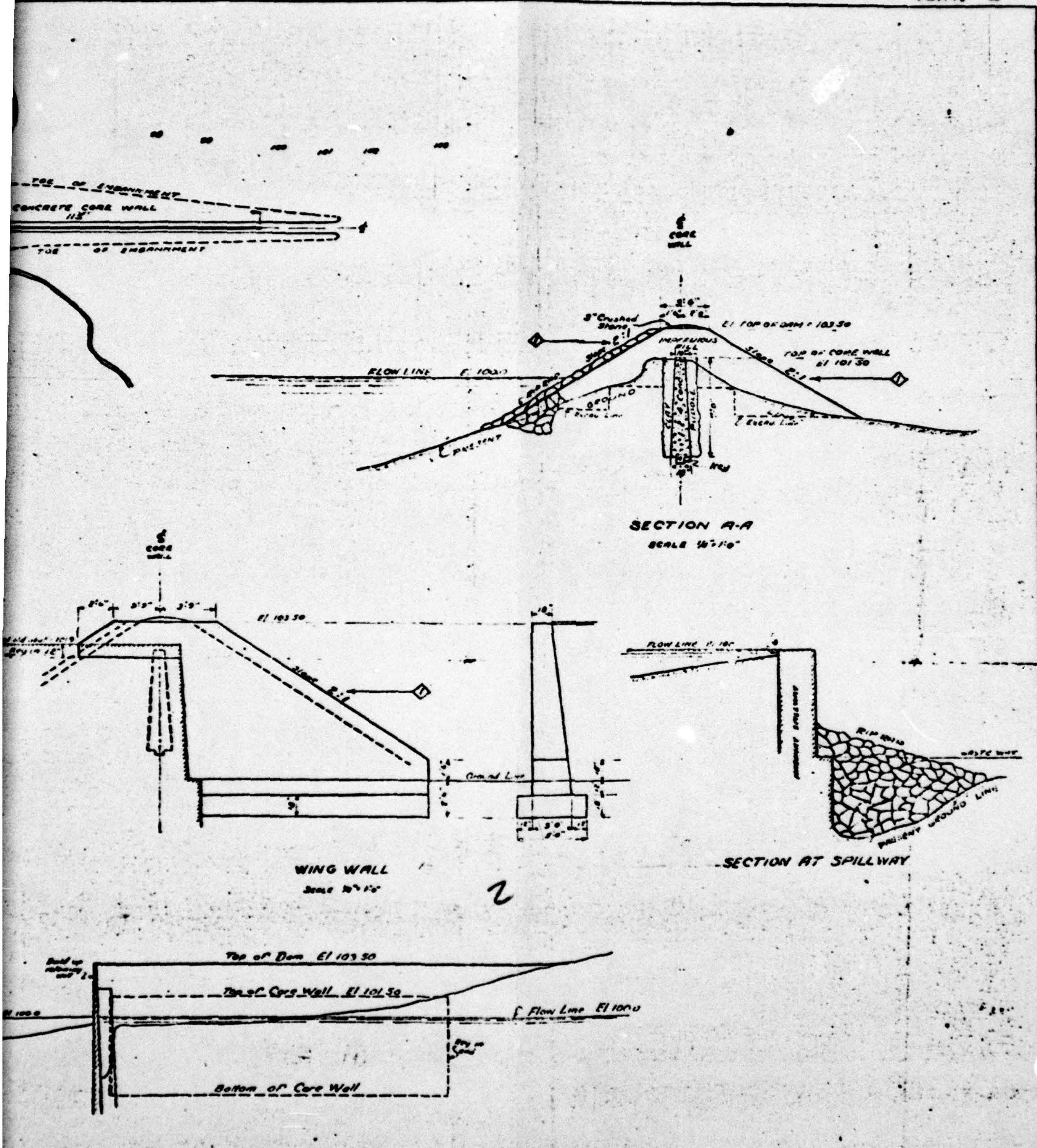


• PLAN VIEW •
SCALE 1"=20'



— ℄ PROFILE —
SCALE – VERT. – 1"=5'
HOR. – 1"=20'

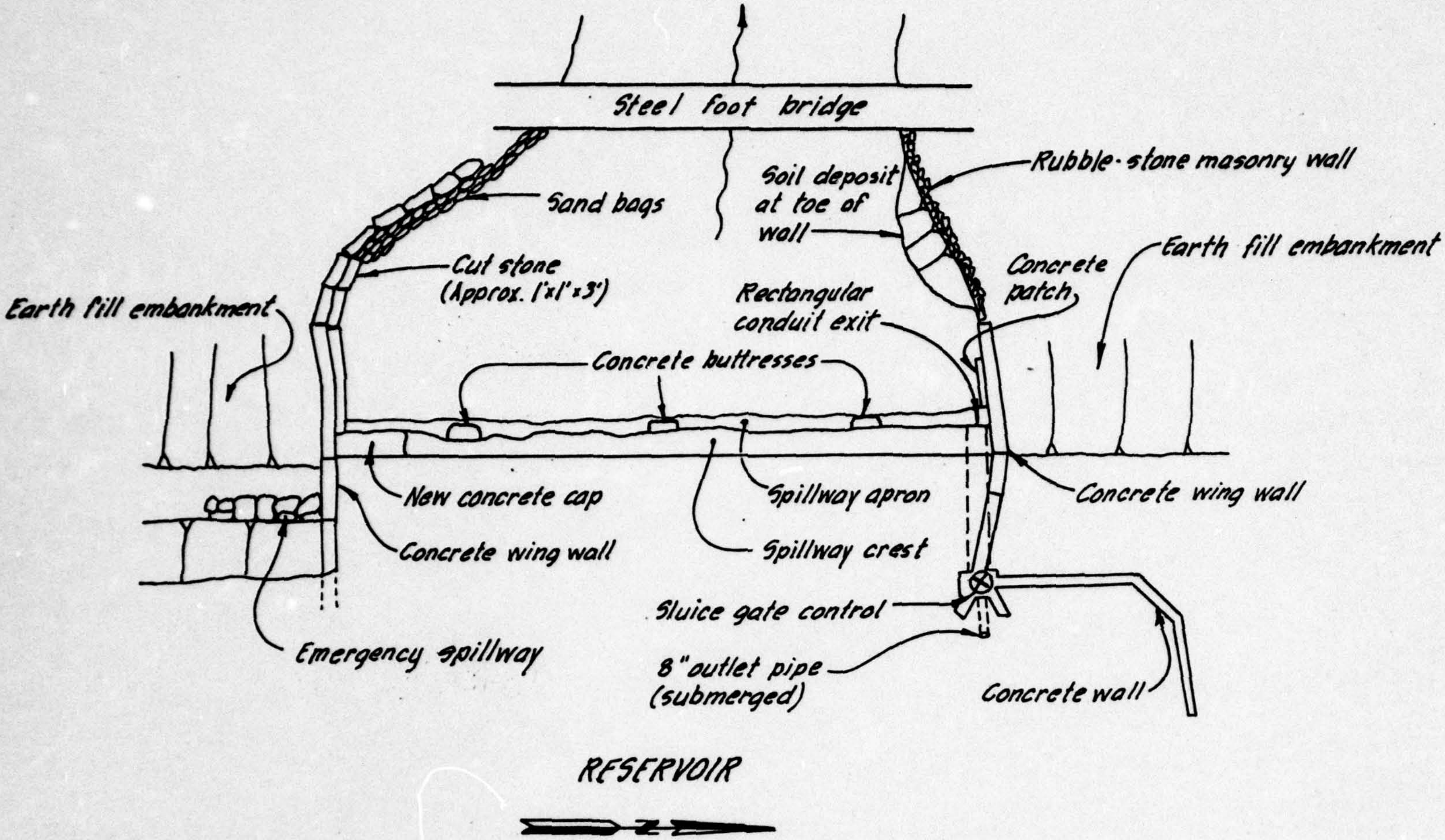
PLATE 2



No	REVISIONS	DATE
1	Bank slopes flattened	

PROPOSED RECONSTRUCTION
OF
LAKE NELSON DAM
AT
NEW MARKET, NJ

OCT 1, 1936 SCALE 1" = 20'



Not to scale

LAKE NELSON DAM

SPILLWAY PLAN

GENERALIZED SKETCH BASED ON DEC. 6, 1978
VISUAL FIELD INSPECTION

JENNY - LEEDSHILL JANUARY 1979

PLATE 3

Photo A View of southern half of spillway (Oct. 28, 1973)
(Photo courtesy of Haefeli Engineering, P.A.)

Photo B View of northern half of spillway (Oct. 28, 1973)
(Photo courtesy of Haefeli Engineering, P.A.)

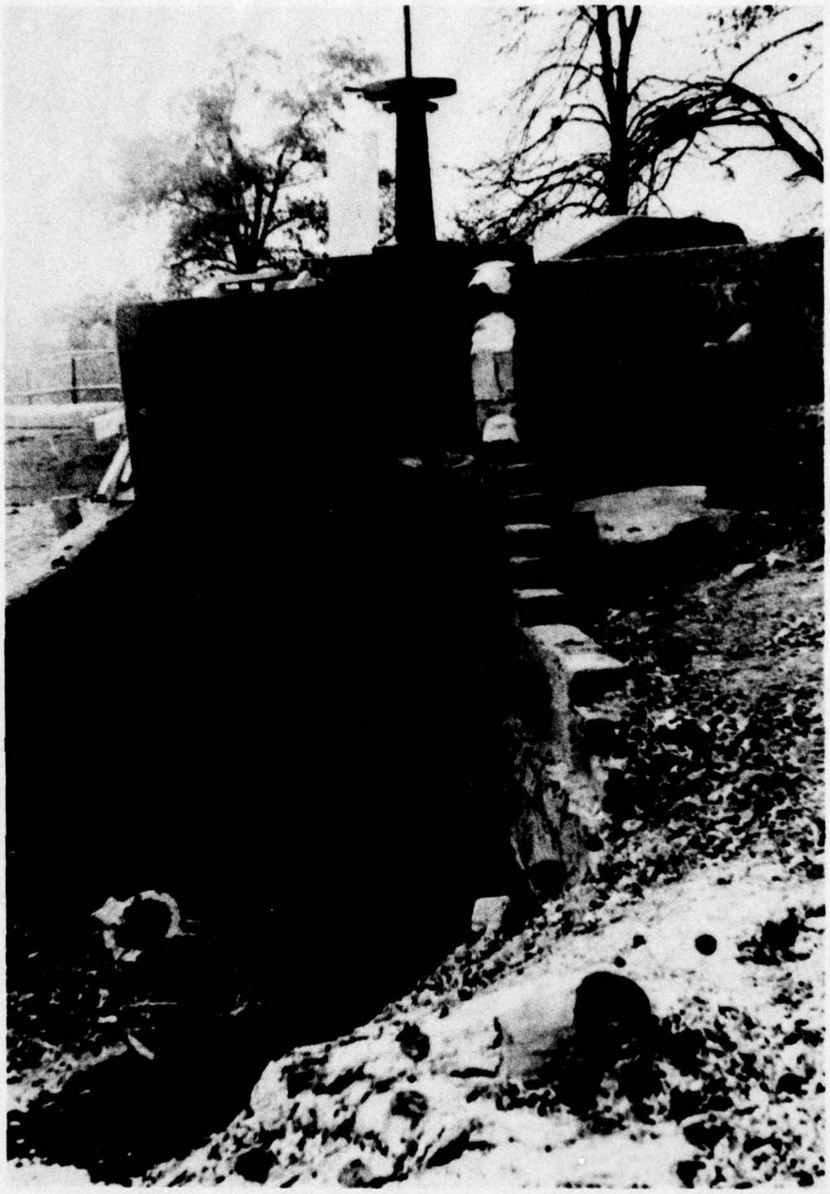


Photo C View of intake to outlet works looking downstream (Oct. 28, 1973)
(Photo courtesy of Haefeli Engineering, P.A.)

APPENDIX A

CHECK LIST - VISUAL OBSERVATIONS

CHECK LIST - ENGINEERING, CONSTRUCTION
MAINTENANCE DATA

Check List
Visual Inspection
Phase 1

Name Dam Lake Nelson **County** Middlesex **State** New Jersey **Coordinator** NJDEP

Coordinates: Lat. 40° 32' 28" N
Long. 74° 26' 40" W

Date(s) Inspection Dec. 6 and 21, 1978 **Weather** Clear **Temperature** 43°F

Pool Elevation at Time of Inspection 56.5 ft M.S.L. (Spillway crest) **Tailwater at Time of Inspection** 49 ft. M.S.L. (Approx.)

Inspection Personnel:

December 6, 1978	December 21, 1978	December 21, 1978
R. C. Gaffin	R. J. Jenny	A. R. Slaughter
P. L. Wagner	D. J. Lachel	
	F. L. Panuzio	

R. C. Gaffin **Recorder**

Owner Representative: (December 6, 1978)
Mrs. L. Loveland - President, Lake Nelson Improvement Assoc.

CONCRETE/MASONRY DAMS
(None)

Lake Nelson

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SEEPAGE OR LEAKAGE	Not Applicable	
STRUCTURE TO ABUTMENT/EMBANKMENT JUNCTIONS	Not Applicable	
DRAINS	Not Applicable	
WATER PASSAGES	Not Applicable	
FOUNDATION	Not Applicable	

CONCRETE/MASONRY DAMS

(None)

Lake Nelson

VISUAL EXAMINATION OF	OBERSVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS CONCRETE SURFACES	Not Applicable	
STRUCTURAL CRACKING	Not Applicable	
VERTICAL AND HORIZONTAL ALIGNMENT	Not Applicable	
MONOLITH JOINTS	Not Applicable	
CONSTRUCTION JOINTS	Not Applicable	

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS	None observed	
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	None observed	
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES	Moderate and locally severe erosion of downstream face of embankment. Erosional gully approximately 20 feet long and 1 to 2 feet deep noted on thedownstream face approximately 125 feet south of left spill-way abutment. Present dam crest is approximately 1.5 feet lower than shown on design plan (Plate 2). Telephone pole located in center of right abutment.	Gully should be filled with suitable earth and compacted.
VERTICAL AND HORIZONTAL ALINEMENT OF THE CREST	Arched shaped embankment, concave upstream. Remains of emergency spillway immediately left of the left abutment of main spill-way, is higher than average embankment crest.	
RIPRAP FAILURES	Riprap approximately 6" x 6" eroded from + 20' long sections approximately 30 and 175 feetsouth of spillway. Riprap is overgrown with grass and disrupted by tree roots.	Riprap should be replaced.

EMBANKMENT

Lake Nelson

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
VEGETATION	Heavy growth of trees and partially covered with grass.	
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM	Some erosion of embankment noted adjacent to left (south) spillway wing wall.	Erosion is probably aggravated by pedestrian traffic.
ANY NOTICEABLE SEEPAGE	None observed	
STAFF GAGE AND RECORDER	None	
DRAINS	None	

OUTLET WORKS

Lake Nelson

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT	Wood debris and loose stones were observed in the outlet conduit. Limited visibility into outlet conduit due to water spilling over spillway.	
INTAKE STRUCTURE	Submerged during the inspection and therefore could not be observed.	Sluice gates were reportedly not operated in numerous years.
OUTLET STRUCTURE	Rectangular conduit 2 ft. x 5 ft. exits at lower right side of spillway. Approximate flow through conduit of about 15 gpm was observed during inspection.	
OUTLET CHANNEL	Same as spillway.	
EMERGENCY GATE	8-in. diameter pipe and sluice gate. See above.	

UNGATED SPILLWAY

Lake Nelson

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE WEIR	Sill is heavily eroded. The left (south) end of the spillway has been repaired with a concrete cap which is approximately 3" higher than the rest of the spillway crest. The base of the two right buttresses have been seriously eroded. Possible leakage through left face of spillway.	Eroded sections of spillway sill, face and buttresses should be repaired.
APPROACH CHANNEL	Considerable sedimentation reported. Water depth $\pm$ 1.5' immediately upstream of spillway crest.	
DISCHARGE CHANNEL	Natural channel of embankment walls revetted with stone and sand bags immediately downstream from spillway. Masonry apron at toe of spillway.	
BRIDGE AND PIERS	Not Applicable	
WING WALLS	Cracking and spalling of both concrete wing walls noted. Crack displacement up to 1 " at left wing wall.	Cracks and spalls should be repaired or wing walls reconstructed.

INSTRUMENTATION
(None)

Lake Nelson

VISUAL EXAMINATION	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
MONUMENTATION/SURVEYS	None	
OBSERVATION WELLS	None	
WEIRS	None	
PIEZOMETERS	None	
OTHER	None	

RESERVOIR

Lake Nelson

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SLOPES	Gentle slopes with single family residents. Grass lawns with few trees.	
SEDIMENTATION	Brown extremely turbid water. Reservoir is reportedly heavily silted.	

DOWNSTREAM CHANNEL

Lake Nelson

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION (OBSTRUCTIONS, DEBRIS, ETC.)	Steel foot bridge located approximately 35 feet downstream from spillway. Flood plain has numerous trees and dense brush.	
SLOPES	Broad flood plain with low, gently sloping adjacent slopes.	
APPROXIMATE NO. OF HOMES AND POPULATION	Approximately 10 single family residents located adjacent to flood plain, at an elevation greater than the spillway crest, visible from dam.	

CHECK LIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION

Lake Nelson

ITEM	REMARKS
PLAN OF DAM	Plan and sections of dam shown on drawing titled, 'Proposed Reconstruction of Lake Nelson Dam,' dated October 1, 1926.
REGIONAL VICINITY MAP	Reservoir is shown on U. S. Geological Survey, Plainfield Quadrangle (Scale 1:24,000).
CONSTRUCTION HISTORY	History of dam is described in "Engineering Report: Lake Nelson Environmental Protection and Improvement, August 1971; prepared by Robert J. Haefeli, P.E., Consulting Engineers, Edison, N.J.
TYPICAL SECTIONS OF DAM	See 'Plan of Dam'
HYDROLOGIC/HYDRAULIC DATA	Lake area-depth curve and reservoir storage curve for various sediment levels are included in 'Engineering Report: Lake Nelson Environmental Protection and Improvement, August 1971; prepared by Robert J. Haefeli, P. E.
OUTLETS - PLAN	See 'Plan of Dam'
- DETAILS -CONSTRAINTS -DISCHARGE RATINGS	Sketches included with letter regarding Lake Nelson Dam Inspection dated Nov. 16, 1973, prepared by Frank and Haefeli Associates, P.A.
RAINFALL/RESERVOIR RECORDS	None Available

CHECK LIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION

Lake Nelson

ITEM	REMARKS
DESIGN REPORTS	None
GEOLOGY REPORTS	None
DESIGN COMPUTATIONS HYDROLOGY & HYDRAULICS DAM STABILITY SEEPAGE STUDIES	Spillway capacity calculations prepared by the State for increase in freeboard, 3/2/27. None None
MATERIALS INVESTIGATIONS BORING RECORDS LABORATORY FIELD	None
POST-CONSTRUCTION SURVEYS OF DAM	None
BORROW SOURCES	Not Known

CHECK LIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION

Lake Nelson

ITEM	REMARKS
SPILLWAY-PLAN -SECTIONS -DETAILS	Plan and section of main spillway shown on drawing titled, 'Proposed Reconstruction of Lake Nelson Dam,' dated Oct. 1, 1926. No information regarding emergency spillway. No details.available.
OPERATING EQUIPMENT PLANS & DETAILS	Not available
MONITORING SYSTEMS	None
MODIFICATIONS	See 'Plan of Dam'
HIGH POOL RECORDS	Not available
POST CONSTRUCTION ENGINEERING STUDIES AND REPORTS	'Engineering Report: Lake Nelson Environmental Protection and Improvement, August, 1971. Report prepared by Robert J. Haefeli, P. E.
PRIOR ACCIDENTS OR FAILURE OF DAM DESCRIPTION REPORTS	Dam has reportedly been overtopped several times and was severely breached in 1926.

CHECK LIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION

Lake Nelson

ITEM	REMARKS
MAINTENANCE OPERATION RECORDS	None Available

APPENDIX B

PHOTOGRAPHS

(Note: All photographs were taken on Dec. 6, 1978)

Photo 1 View of downstream face of south embankment looking north

Photo 2 View of upstream face of dam from south abutment looking north

Photo 3 View of embankment crest looking south from spillway

Photo 4 View of spillway crest looking north

Photo 5 View of downstream face of spillway at left (south) abutment

Photo 6 View of downstream face of spillway looking north

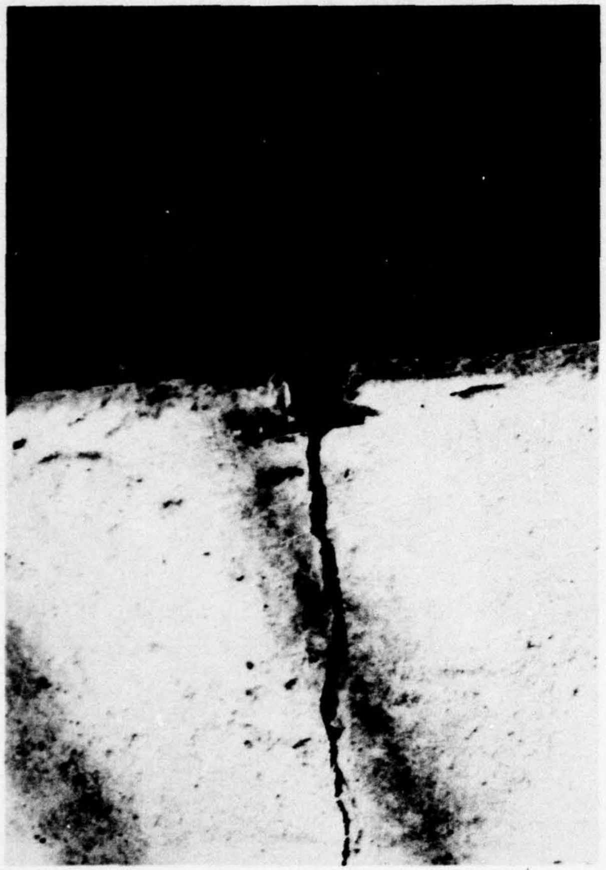


Photo 7 Vertical view of crack at center of left (south) wing wall

Photo 8 View of crack in left (south) wing wall just downstream of spillway crest

Photo 9 Overview of right (north
spillway abutment

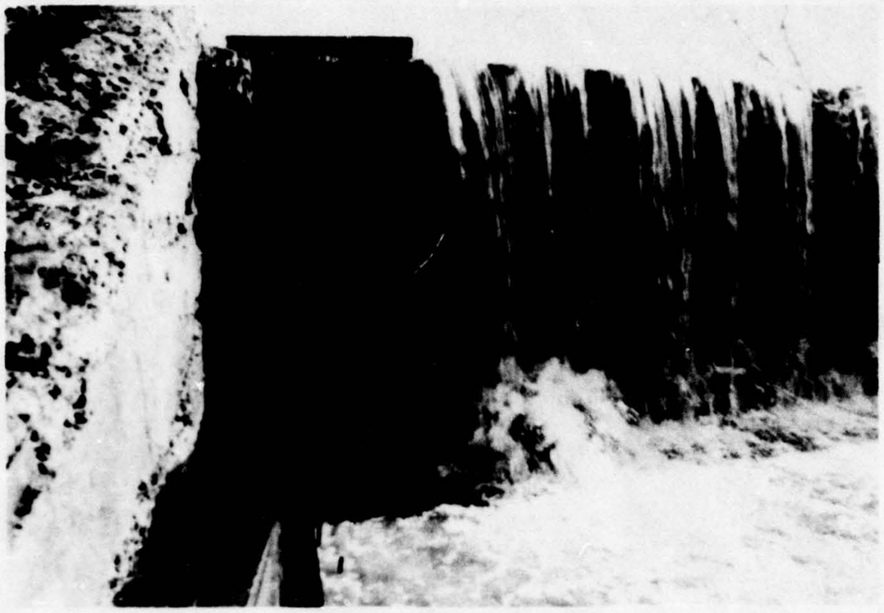


Photo 10 View of downstream face of spillway showing outlet conduit
(Board placed on spillway crest is not part of the structure)

Photo 11 View looking downstream from spillway crest

APPENDIX C

REGIONAL GEOLOGY - PIEDMONT LOWLANDS

REGIONAL GEOLOGY - PIEDMONT LOWLANDS

Physiography

The Piedmont Lowlands Province of New Jersey lies northwest of a line approximately between Trenton and Perth Amboy and southeast of an approximate line between Milford on the Delaware River and Mahwah near the New York State border. Physiographically, the province is situated between the predominantly Precambrian age New Jersey Highlands Province to the northwest and the typically unconsolidated Createaceous age and younger sediments of the Coastal Plain Province to the southeast. (See Figure C-1).

Bedrock

The Piedmont Lowlands, encompassing about one-fifth of the state, is characterized by northwestward dipping bedrock composed of interbedded red shales, siltstones and sandstones of Triassic and Jurassic age and igneous basalt extrusions (lava flows) and diabase intrusions of Jurassic age. The sedimentary rocks have been eroded to a broad southeastward sloping piedmont plain. The northwest border of the province is a northeast-southwest trending fault zone (Ramapo Fault) which truncates the sedimentary beds. Total vertical displacement on the fault may reach 10,000 feet.

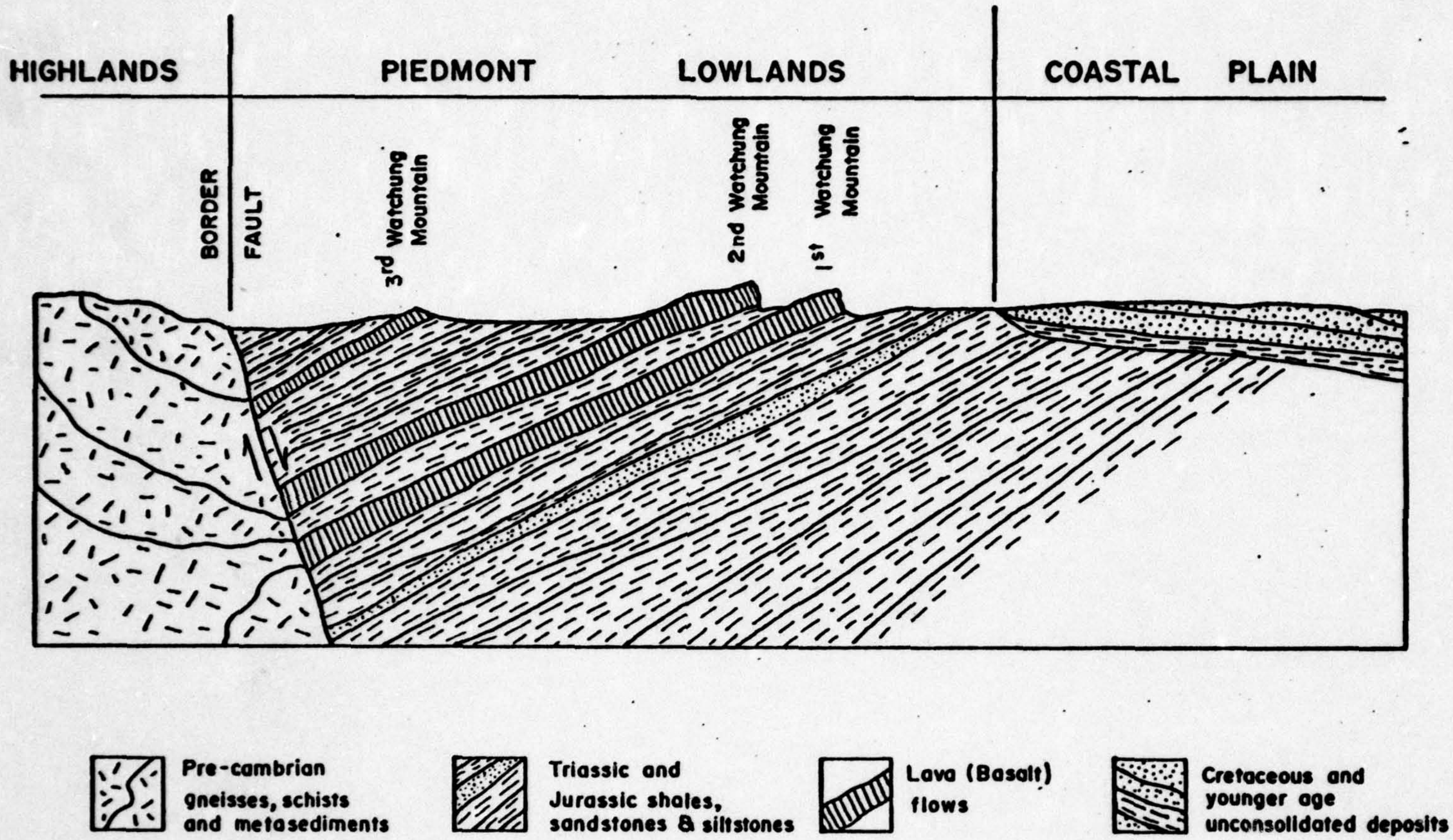
The gently rolling lowland topography of the piedmont lowlands is pierced by long asymetric ridges of hard

and resistant igneous rocks which were intruded into or on top of the sedimentary sequences. With the subsequent erosion of the softer sedimentary rocks, these igneous formations have been left standing, often in bold relief, up to 400 ft. above the surrounding plains. The igneous bodies composed of diabase and basalt form the Palisades along the Hudson River and the three Watchung Mountain ridges of the central Piedmont. The ridges are all steeper on the southeast with gentle dip slopes to the northwest.

Overburden

The Pleistocene Age Wisconsin continental glacier has smoothed and filled approximately the northern half of the province. The terminal moraine of the glacier extends from Perth Amboy to Summit then northwestward to Morris Plains. North of the morainal line the soils characteristically consist of glacial tills overlying the bedrock with scattered overlying stratified outwash deposits. At least three large glacial lakes occupied portions of the area north of the moraine at different periods, resulting in a relatively flat topography composed predominantly of silts and clays.

South of the terminal moraine, most of the overburden consists of alluvial deposits overlying a more highly developed weathered transition zone on top of the bedrock. Some highly weathered tills of pre-Wisconsin glaciation can be found on the top of intervalley ridges. Much of the alluvium is glacial outwash.



SCHEMATIC CROSS-SECTION OF
NEW JERSEY PIEDMONT LOWLANDS
PHYSIOGRAPHIC PROVINCE

JENNY / LEEDSHILL
JANUARY 1979

FIGURE C-1

APPENDIX D

HYDROLOGIC AND HYDRAULIC COMPUTATIONS

CHECK LIST
HYDROLOGIC AND HYDRAULIC DATA
ENGINEERING DATA

DRAINAGE AREA CHARACTERISTICS: 5.0 sq. mi.

ELEVATION TOP NORMAL POOL (STORAGE CAPACITY): 56.5 ft (40 AF)

ELEVATION TOP FLOOD CONTROL POOL (STORAGE CAPACITY): N/A

ELEVATION MAXIMUM DESIGN POOL: 60.3 ft.

ELEVATION TOP DAM: 58.5 FT

CREST: Spillway

- a. Elevation 56.5 FT
- b. Type Masonry wall
- c. Width ± 3'
- d. Length 83'
- e. Location Spillover Northern Third
- f. Number and Type of Gates None

OUTLET WORKS:

- a. Type 1-8" PIPE (Wooden sluice gate: inoperable)
- b. Location Right side of spillway
- c. Entrance inverts 50.5 FT
- d. Exit inverts 48.3 ft
- e. Emergency draindown facilities Same as (a)

HYDROMETEOROLOGICAL GAGES: None

- a. Type
- b. Location
- c. Records

MAXIMUM NON-DAMAGING DISCHARGE: 610 CFS

LEEDS, HILL AND JEWETT, INC.

BY RBE DATE 790111 CLIENT N.J. SHEET NO. OF

CHKD DATE JOB LAKE NELSON JOB NO. 302-03

RAINFALL DURATION CURVE

REF. [1] DURATION <1 hr HYDRO-35 "FIVE TO 60 MINUTE PRECIPITATION FREQUENCY FOR THE EASTERN AND CENTRAL UNITED STATES" JUNE 1977 NOAA

[2] DURATION >1 hr TECH PAPER NO. 40 "RAINFALL FREQUENCY ATLAS OF THE UNITED STATES" U.S. DEPT OF COMMERCE MAY 1961

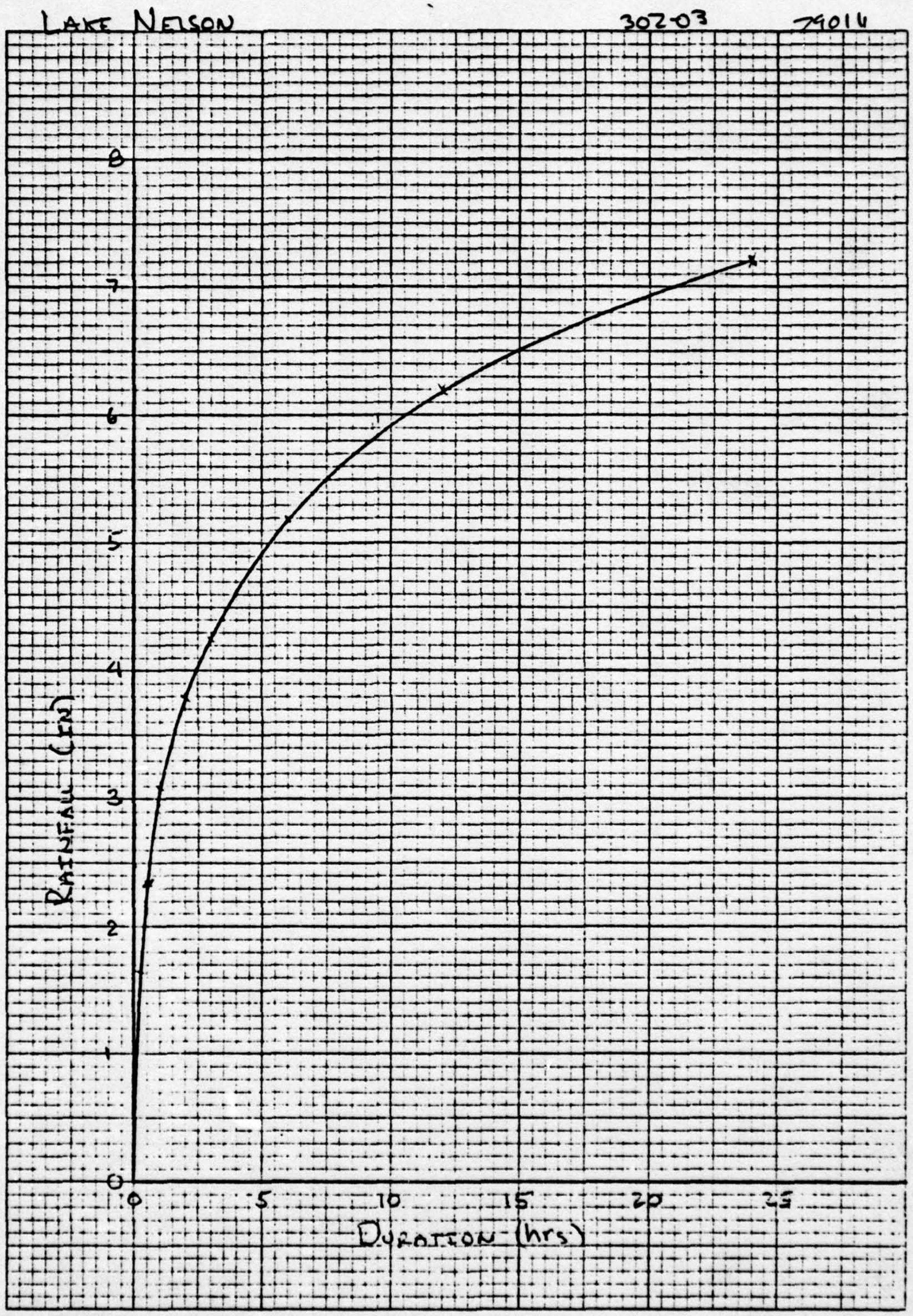
CENTROID LOCATION LAT. 40° 32' LONG. 74° 25'

100 YEAR

DURATION (hrs)	RAINFALL (IN)		
1/4	1.64 [1]		
1/2	2.33 [1]		
1	3.1 [2]	3.05 [1]	USE 3.1
2	3.8 [2]		
3	4.25 [2]		
6	5.2 [2]		
12	6.2 [2]		
24	7.2 [2]		

$t_{30\,min} = 0.49\ t_{60\,min} + 0.51\ t_{15\,min}$ [1]

$t_{30\,min} = 2.33''$



CLEARPRINT PAPER CO. C38 10 X 10 DIVISIONS PER INCH. 70 X 100 DIVISIONS. PRINTED IN U.S.A. ON CLEARPRINT TECHNICAL PAPER NO. 1015

CHAMPION LINE NO. C36-P **LEEDS, HILL AND JEWETT, INC.**

BY RBE DATE 790111 CLIENT N.T SHEET NO. ____ OF ____

CHKD. ____ DATE ____ JOB Lake Nelson JOB NO. 302-03

Duration (hrs)	Rainfall (in) Δ	Σ	Pattern	Duration hrs	Rainfall (in) Σ	Δ	Pattern
0	0	0		12 1/4		.02	0.42
1/4	1.64	1.64		12 1/2			0.2
1/2	2.33	0.69		12 3/4			0.15
3/4	2.75	0.42		13			0.1
1	3.1	0.35		13 1/4			0.15
1 1/4	3.3	0.2		13 1/2			0.1
1 1/2	3.5	0.2		13 3/4			0.05
1 3/4	3.65	0.15		14			0.1
2	3.8	0.15		14 1/4			0.05
2 1/4	3.9	0.1		14 1/2			0.1
2 1/2	4.0	0.1		14 3/4			0.05
2 3/4	4.15	0.15		15			0.04
3	4.25	0.10		15 1/4			
3 1/4	4.35	0.10		15 1/2			
3 1/2	4.45	0.10		15 3/4			
3 3/4	4.5	0.05		16			
4	4.6	0.1		16 1/4			
4 1/4	4.7	0.1		16 1/2			
4 1/2	4.8	0.1		16 3/4			
4 3/4	4.85	0.05		17			
5	4.9	0.05		17 1/4			
5 1/4	5.0	0.1		17 1/2			
5 1/2	5.05	0.05		17 3/4			
5 3/4	5.1	0.05	0.02	18			0.02
6	5.2	0.1		18 1/4			
6 1/4	5.25	0.04		18 1/2			
6 1/2	5.3			18 3/4			
6 3/4	5.35			19			
7	5.4			19 1/4			
7 1/4	5.45			19 1/2			
7 1/2	5.5			19 3/4			
7 3/4	5.55			20			
8	5.6			20 1/4			
8 1/4	5.65			20 1/2			
8 1/2	5.7			20 3/4			
8 3/4	5.75		.04	21			
9	5.75		0.1	21 1/4			
9 1/4	5.8		0.05	21 1/2			
9 1/2	5.85		0.05	21 3/4			
9 3/4	5.9		0.1	22			
10	5.9		0.1	22 1/4			
10 1/4	5.95		0.1	22 1/2			
10 1/2	6.0		0.1	22 3/4			
10 3/4	6.0		0.1	23			
11	6.05		0.15	23 1/4			
11 1/4	6.1		0.2	23 1/2			
11 1/2	6.1		0.35	23 3/4			
11 3/4	6.15		0.69	24	7.2		
12	6.2		1.64				

DATA

L = STREAM LENGTH FROM WATERSHED OUTLET TO THE MOST DISTANT RIDGE = 4.55 mi

LCA = STREAM LENGTH FROM BASIN CENTROID = 1.93 mi

H = DIFF BETWEEN ELEV. AT OUTLET AND ELEV AT MOST DISTANT POINT = 85'

T_C = TIME OF CONCENTRATION OR TIME FOR WATER TO FLOW FROM THE MOST DISTANT POINT IN THE WATERSHED TO THE WATERSHED OUTLET

T_L = LAG TIME FROM CENTER OF EXCESS RAINFALL TO TIME OF PEAK. $= 0.6 T_C$

METHOD 1

$$T_C = \frac{L^{1.15}}{7700\, H^{0.38}}$$

L IN FT
H IN FT

$$T_L = \frac{0.6\, L^{1.15}}{7700\, H^{0.38}}$$

METHOD 2

$$T_C = \left(\frac{11.9\, L^3}{H}\right)^{0.385}$$

L IN MILES
H IN FT.

$$T_L = 0.6 \left(\frac{11.9\, L^3}{H}\right)^{0.385}$$

METHOD 3

$$T_L = C_T \left(\frac{L L_c}{S^{1/2}}\right)^{0.38}$$

S IN FT/MI $S = H/L = .35\%$

$$T_L = C_T \left(\frac{L L_c}{(H/L)^{1/2}}\right)^{0.38}$$

$C_T = 1.2$ MOUNTAIN
$= 0.72$ FOOTHILL
$= 0.35$ VALLEY DRAINAGE AREA

METHOD 4

$T_C = L/V$

$T_L = 0.6\, L/V$

V = AVG VELOCITY FROM CURVE OF V VS. AVG SLOPE
V = 0.8 fps

LAG IN HOURS

DAM	METHODS 1	2	3	4	USE
LAKE NELSON	1.6	1.6	2.3	5.0	2.0

LEEDS, HILL AND JEWETT, INC.

BY DBE DATE ____ CLIENT N.J. DAM SAFETY SHEET NO. ____ OF ____

CHKD ____ DATE ____ JOB ____ JOB NO. 302-03

REFERENCES

METHOD 1 - FROM "HANDBOOK OF APPLIED HYDROLOGY"
BY CHOW
MCGRAW HILL PP 21-10, 11

METHOD 2 - FROM CALIFORNIA CULVERTS PRACTICE, CALIF
HIGHWAYS AND PUBLIC WORKS, SEPT 1942
SEE USBR DESIGN OF SMALL DAMS
PG. 71

METHOD 3 - FROM HYDROLOGY FOR ENGINEERS
LINSLEY/KOHLER/PAULHUS 1975
PP 247-248

METHOD 4 - FROM U.S. NAVY - TECHNICAL PUBLICATION
NAVDOCKS TP-PW-5 TABLE 8B, MARCH 1953
SEE USBR DESIGN OF SMALL DAMS PG. 70

ASSUMED BREACH PARAMETERS [1]

WIDTH OF BREACH BOTTOM: 410'

SIDE SLOPES: 45° (1:1)

BOTTOM ELEVATION: 50.5 FT

TIME TO FAIL: 2.0 hrs

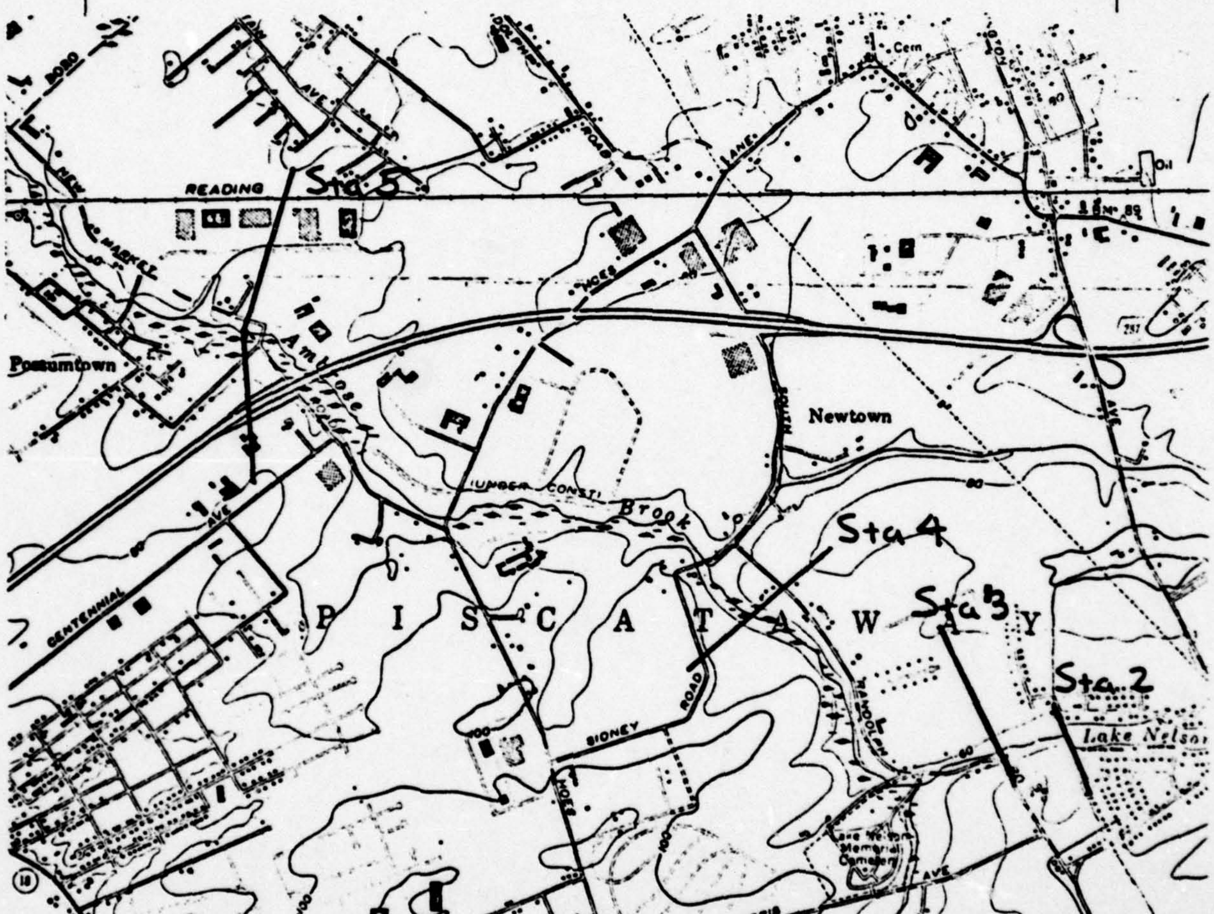
ELEVATION AT WHICH FAILURE OCCURS: 58.5 FT

INITIAL WATER SURFACE ELEVATION: 56.5 FT

[1] BASED ON PREVIOUS STUDIES OF ACTUAL DAM FAILURES.

RBE 790207 | LAKE NELSON | 302-03

LOCATION MAP OF CROSS-SECTIONS USED IN ROUTING CALCULATIONS



LEEDS, HILL AND JEWETT, INC.

BY RBE DATE 790105 CLIENT New Jersey SHEET NO. ___ OF ___

CHKD. ___ DATE ___ JOB Lake Nelson JOB NO. 202-01

598
153
87

Lake Nelson

Channel Cross-Sections ℄

Station	Distance Downstream of Dam (ft)	Manning's "n" Left Overbank	Manning's "n" Main Channel	Manning's "n" Right Overbank	Channel Invert (ft)	Max Elev. (ft)	Reach Length (ft)	Energy Grade Line Slope	X or Y	1	2	3	4	5	6	7	8
2 - Below Dam	1000	.05	.045	.05	49	80	1000	.001	X	0	1100	1800	1800	1815	1825	2000	2200
									Y	80	60	54	49	49	54	60	80
3	5900	.05	.045	.05	46	80	4900	.001	X	0	900	1100	1100	1125	1125	1250	1600
									Y	80	60	49	46	46	49	60	80
4	14600	.05	.045	.05	40	800	8700	.001	X	0	1000	2300	2300	2325	2325	2900	4300
									Y	80	60	43	40	40	43	60	80

X or Y (ft)

℄ Looking Upstream

D-9

TABLE 5-6. VALUES OF THE ROUGHNESS COEFFICIENT n (*continued*)

Type of channel and description	Minimum	Normal	Maximum
C. EXCAVATED OR DREDGED			
a. Earth, straight and uniform			
1. Clean, recently completed	0.016	0.018	0.020
2. Clean, after weathering	0.018	0.022	0.025
3. Gravel, uniform section, clean	0.022	0.025	0.030
4. With short grass, few weeds	0.022	0.027	0.033
b. Earth, winding and sluggish			
1. No vegetation	0.023	0.025	0.030
2. Grass, some weeds	0.025	0.030	0.033
3. Dense weeds or aquatic plants in deep channels	0.030	0.035	0.040
4. Earth bottom and rubble sides	0.028	0.030	0.035
5. Stony bottom and weedy banks	0.025	0.035	0.040
6. Cobble bottom and clean sides	0.030	0.040	0.050
c. Dragline-excavated or dredged			
1. No vegetation	0.025	0.028	0.033
2. Light brush on banks	0.035	0.050	0.060
d. Rock cuts			
1. Smooth and uniform	0.025	0.035	0.040
2. Jagged and irregular	0.035	0.040	0.050
e. Channels not maintained, weeds and brush uncut			
1. Dense weeds, high as flow depth	0.050	0.080	0.120
2. Clean bottom, brush on sides	0.040	0.050	0.080
3. Same, highest stage of flow	0.045	0.070	0.110
4. Dense brush, high stage	0.080	0.100	0.140
D. NATURAL STREAMS			
D-1. Minor streams (top width at flood stage <100 ft)			
a. Streams on plain			
1. Clean, straight, full stage, no rifts or deep pools	0.025	0.030	0.033
2. Same as above, but more stones and weeds	0.030	0.035	0.040
3. Clean, winding, some pools and shoals	0.033	0.040	0.045
4. Same as above, but some weeds and stones	0.035	0.045	0.050
5. Same as above, lower stages, more ineffective slopes and sections	0.040	0.048	0.055
6. Same as 4, but more stones	0.045	0.050	0.060
7. Sluggish reaches, weedy, deep pools	0.050	0.070	0.080
8. Very weedy reaches, deep pools, or floodways with heavy stand of timber and underbrush	0.075	0.100	0.150

STATION 2, 3, 4

D-10

TABLE 5-6. VALUES OF THE ROUGHNESS COEFFICIENT n (continued)

Type of channel and description	Minimum	Normal	Maximum
b. Mountain streams, no vegetation in channel, banks usually steep, trees and brush along banks submerged at high stages			
1. Bottom: gravels, cobbles, and few boulders	0.030	0.040	0.050
2. Bottom: cobbles with large boulders	0.040	0.050	0.070
D-2. Flood plains			
a. Pasture, no brush			
1. Short grass	0.025	0.030	0.035
2. High grass	0.030	0.035	0.050
b. Cultivated areas			
1. No crop	0.020	0.030	0.040
2. Mature row crops	0.025	0.035	0.045
3. Mature field crops	0.030	0.040	0.050
c. Brush			
1. Scattered brush, heavy weeds	0.035	0.050	0.070
2. Light brush and trees, in winter	0.035	0.050	0.060
3. Light brush and trees, in summer	0.040	0.060	0.080
4. Medium to dense brush, in winter	0.045	0.070	0.110
5. Medium to dense brush, in summer	0.070	0.100	0.160
d. Trees			
1. Dense willows, summer, straight	0.110	0.150	0.200
2. Cleared land with tree stumps, no sprouts	0.030	0.040	0.050
3. Same as above, but with heavy growth of sprouts	0.050	0.060	0.080
4. Heavy stand of timber, a few down trees, little undergrowth, flood stage below branches	0.080	0.100	0.120
5. Same as above, but with flood stage reaching branches	0.100	0.120	0.160
D-3. Major streams (top width at flood stage >100 ft). The n value is less than that for minor streams of similar description, because banks offer less effective resistance.			
a. Regular section with no boulders or brush	0.025	.....	0.060
b. Irregular and rough section	0.035	.....	0.100

OPEN-CHANNEL HYDRAULICS

STATION 2, 3, 4

VEN TE CHOW, Ph.D.
Professor of Hydraulic Engineering
University of Illinois

DRAWDOWN CALCULATION

	Elev ft	Sto AF	ΔSto AF	Mean Head ft	Incr. Time, HR	Cum Time HRS
Spillway →	56.5	40				
			14	5.5	43.0	43.0
	55.5	26				
			12	4.5	40.7	83.7
	54.5	14				
			9	3.5	34.6	118.3
	53.5	5				
			5	1.5	29.4	147.7
	50.5	0				

USE orifice equation

$$Q = CA\sqrt{2gH}$$

Assume $C = 0.6$

$$Q = 0.6\left[\frac{\pi}{4}\left(\frac{8}{12}\right)^2\right]\sqrt{2g}\,\sqrt{H}$$

$$Q = 1.68\,H^{1/2}$$

Total time to drain = 147.7 HRS /24 = 6.2 days.

THIS CALCULATION ASSUMES OUTLET OPERATIONAL WITH NO TAILWATER OR INFLOWS INTO RESERVOIR

No Breach
Calc.

```
**********************************
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION       JULY 1978
  LAST MODIFICATION  25 SEP 78
**********************************
   1        A1      NEW JERSEY DAM SAFETY - LAKE NELSON DAM  I.D. NJ 00376
   2        A2      HYDRAULIC-HYDROLOGIC ANALYSIS   302-03
   3        A3      PROBABLE MAXIMUM FLOOD                                          -PBE-
   4        B     96       0      15       0       0       0       0       0       0       0
   5        B1     5
   6        J      1       4       1
   7        J1   0.1    0.25    0.50    1.00
   8        K      0       1                                       1
   9        K1                         INFLOW HYDROGRAPH TO RESERVOIR
  10        M      0       2     5.0             5.0                                       1
  11        O     96
  12        O1  0.02    0.02    0.02    0.02    0.02    0.02    0.02    0.02    0.02    0.02
  13        O1  0.02    0.02    0.02    0.02    0.02    0.02    0.02    0.02    0.02    0.02
  14        O1  0.02    0.02    0.02    0.02    0.04    0.04    0.04    0.04    0.04    0.04
  15        O1  0.04    0.04    0.04    0.04    0.04    0.04     0.1    0.05    0.05     0.1
  16        O1   0.1     0.1     0.1     0.1    0.15     0.2    0.35    0.69    1.64    0.42
  17        O1   0.2    0.15     0.1    0.15     0.1    0.05     0.1    0.05     0.1    0.05
  18        O1  0.04    0.04    0.04    0.04    0.04    0.04    0.04    0.04    0.04    0.04
  19        O1  0.04    0.04    0.02    0.02    0.02    0.02    0.02    0.02    0.02    0.02
  20        O1  0.02    0.02    0.02    0.02    0.02    0.02    0.02    0.02    0.02    0.02
  21        O1  0.02    0.02    0.02    0.02    0.02    0.02
  22        T                                                    0.5    0.05
  23        W2           2.0
  24        X     -1    -.05     2.0
  25        K      1       2                                       1
  26        K1                        ROUTED FLOWS THROUGH RESERVOIR
  27        Y                                   1       1
  28        Y1     1                                              40
  29        SS     0       5      14      26      40     100     140     250     523
  30        SE  53.5    53.5    54.5    55.5    56.5      59      60      62      65
  31        SS  56.5      63     2.6     1.5
  32        SD  58.5     2.6     1.5     410
  33        K      1       3                                       1
  34        K1      CHANNEL ROUTING -MODIFIED PULS- STATION 2 TO 3
  35        Y                                   1       1
  36        Y1     1
  37        Y6  0.05   0.045    0.05      49      60    1000   0.061
  38        Y7     0      49    1600      60    1000      54    1000      49    1025      49
  39        Y7  1025      54    2900      60    2200      60
  40        K      1       4                                       1
  41        K1      CHANNEL ROUTING -MODIFIED PULS- STATION 3 TO 4
  42        Y                                   1       1
  43        Y1     1
  44        Y6  0.05   0.045    0.05      46      60    4900   0.001
  45        Y7     0      60     900      60    1133      49    1100      46    1125      46
  46        Y7  1125      49    1250      60    1903      60
  47        K      1       5                                       1
  48        K1      CHANNEL ROUTING -MODIFIED PULS- STATION 4 TO 5
  49        Y                                   1       1
  50        Y1     1

  51        Y6  0.05   0.045    0.35      40      60    8700   0.001
  52        Y7     0      60    1000      60    2303      43    2340      40    2325      40
  53        Y7  2325      43    2900      60    4300      60
  54        K     99
```

D-2

```
********************************
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION      JULY 1978
  LAST MODIFICATION  25 SEP 78
********************************

RUN  DATE* 01/11/79
     TIME* 21.37.20.


          NEW JERSEY DAM SAFETY - LAKE NELSON DAM  I.D. NO 00376
          HYDRAULIC-HYDROLOGIC ANALYSIS   302-03
          PROBABLE MAXIMUM FLOOD                                         -RBE-

                                  JOB SPECIFICATION
      NQ     NHR    NMIN    IDAY     IHR    IMIN   METRC    IPLT    IPRT   NSTAN
      96       0      15       0       0       0       0       0       0       0
                            JOPER     NWT   LROPT   TRACE
                               5       0       0       0

                         MULTI-PLAN ANALYSES TO BE PERFORMED
                           NPLAN= 1 NRTIO= 4 LRTIO= 1
      RTIOS=    .10    .25    .50   1.00


  *********        *********        *********        *********        *********

                              SUB-AREA RUNOFF COMPUTATION

                             INFLOW HYDROGRAPH TO RESERVOIR

              ISTAQ   ICOMP   IECON   ITAPE    JPLT    JPRT   INAME  ISTAGE   IAUTO
                  1       0       0       0       0       0       1       0       0

                                     HYDROGRAPH DATA
      IHYDG    IUHG   TAREA    SNAP   TRSDA   TRSPC   RATIO   ISNOW   ISAME   LOCAL
          0       2    5.00    0.00    5.00    6.00   0.000       0       1       0

                                       PRECIP DATA
                                 NP   STORM     DAJ     DAK
                                 96    0.00    0.00    0.00
                                     PRECIP PATTERN
   .02       .02       .02       .02       .02       .02       .02       .02       .02       .02
   .02       .02       .02       .02       .02       .02       .02       .02       .02       .02
   .02       .02       .02       .02       .04       .04       .04       .04       .04       .04
   .04       .04       .04       .04       .04       .04       .10       .05       .05       .10
   .10       .10       .10       .10       .15       .20       .35       .69      1.64       .42
   .20       .15       .10       .15       .10       .05       .10       .05       .10       .05
   .04       .04       .04       .04       .04       .04       .04       .04       .04       .04
   .04       .04       .02       .02       .02       .02       .02       .02       .02       .02
   .02       .02       .02       .02       .02       .02       .02       .02       .02       .02
   .02       .02       .02       .02       .02       .02

                                        LOSS DATA
  LROPT   STRKR   DLTKR   RTIOL   ERAIN   STRKS   RTIOK   STRTL   CNSTL   ALSMX   RTIMP
      0    0.00    0.00    1.00    0.00    0.00    1.00     .50     .05    0.00    0.00

                                  UNIT HYDROGRAPH DATA
                              TC=  0.00     LAG=  2.00

                                    RECESSION DATA
                      STRTQ=   -1.00    QRCSN=    -.05    RTIOR= 2.00

      UNIT HYDROGRAPH 42 END OF PERIOD ORDINATES, TC=    0.00 HOURS, LAG=   2.00  VOL= 1.00
    49.      159.      280.      486.      724.      939.     1072.     1129.     1129.     1072.
   961.      872.      732.      583.      471.      387.      314.      263.      223.      183.
   151.      124.      103.       85.       70.       57.       47.       40.       32.       27.
    22.       19.       15.       12.       11.        9.        8.        6.        5.        3.
     2.        1.
```

D-13.

END-OF-PERIOD FLOW

MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q	MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q
1.01	.15	1	.02	0.00	.02	5.	1.01	12.15	49	1.64	1.63	.01	1140.
1.01	.30	2	.02	0.00	.02	4.	1.01	12.30	50	.42	.41	.01	1534.
1.01	.45	3	.02	0.00	.02	4.	1.01	12.45	51	.20	.19	.01	2331.
1.01	1.00	4	.02	0.00	.02	4.	1.01	13.00	52	.15	.14	.01	2835.
1.01	1.15	5	.02	0.00	.02	4.	1.01	13.15	53	.10	.09	.01	3287.
1.01	1.30	6	.02	0.00	.02	3.	1.01	13.30	54	.15	.14	.01	3536.
1.01	1.45	7	.02	0.00	.02	3.	1.01	13.45	55	.10	.09	.01	4195.
1.01	2.00	8	.02	0.00	.02	3.	1.01	14.00	56	.05	.04	.01	4351.
1.01	2.15	9	.02	0.00	.02	3.	1.01	14.15	57	.10	.09	.01	4337.
1.01	2.30	10	.02	0.00	.02	3.	1.01	14.30	58	.05	.04	.01	4174.
1.01	2.45	11	.02	0.00	.02	2.	1.01	14.45	59	.10	.09	.01	3904.
1.01	3.00	12	.02	0.00	.02	2.	1.01	15.00	60	.05	.04	.01	3555.
1.01	3.15	13	.02	0.00	.02	2.	1.01	15.15	61	.04	.03	.01	3145.
1.01	3.30	14	.02	0.00	.02	2.	1.01	15.30	62	.04	.03	.01	2733.
1.01	3.45	15	.02	0.00	.02	2.	1.01	15.45	63	.04	.03	.01	2301.
1.01	4.00	16	.02	0.00	.02	2.	1.01	16.00	64	.04	.03	.01	2086.
1.01	4.15	17	.02	0.00	.02	2.	1.01	16.15	65	.04	.03	.01	1831.
1.01	4.30	18	.02	0.00	.02	1.	1.01	16.30	66	.04	.03	.01	1615.
1.01	4.45	19	.02	0.00	.02	1.	1.01	16.45	67	.04	.03	.01	1418.
1.01	5.00	20	.02	0.00	.02	1.	1.01	17.00	68	.04	.03	.01	1244.
1.01	5.15	21	.02	0.00	.02	1.	1.01	17.15	69	.04	.03	.01	1097.
1.01	5.30	22	.02	0.00	.02	1.	1.01	17.30	70	.04	.03	.01	970.
1.01	5.45	23	.02	0.00	.02	1.	1.01	17.45	71	.04	.03	.01	865.
1.01	6.00	24	.02	0.00	.02	1.	1.01	18.00	72	.04	.03	.01	774.
1.01	6.15	25	.04	.01	.03	2.	1.01	18.15	73	.02	.01	.01	696.
1.01	6.30	26	.04	.03	.01	4.	1.01	18.30	74	.02	.01	.01	635.
1.01	6.45	27	.04	.03	.01	10.	1.01	18.45	75	.02	.01	.01	586.
1.01	7.00	28	.04	.03	.01	21.	1.01	19.00	76	.02	.01	.01	536.
1.01	7.15	29	.04	.03	.01	37.	1.01	19.15	77	.02	.01	.01	482.
1.01	7.30	30	.04	.03	.01	63.	1.01	19.30	78	.02	.01	.01	435.
1.01	7.45	31	.04	.03	.01	88.	1.01	19.45	79	.02	.01	.01	390.
1.01	8.00	32	.04	.03	.01	114.	1.01	20.00	80	.02	.01	.01	348.
1.01	8.15	33	.04	.03	.01	149.	1.01	20.15	81	.02	.01	.01	310.
1.01	8.30	34	.04	.03	.01	179.	1.01	20.30	82	.02	.01	.01	276.
1.01	8.45	35	.04	.03	.01	207.	1.01	20.45	83	.02	.01	.01	246.
1.01	9.00	36	.04	.03	.01	231.	1.01	21.00	84	.02	.01	.01	220.
1.01	9.15	37	.10	.09	.01	254.	1.01	21.15	85	.02	.01	.01	205.
1.01	9.30	38	.05	.04	.01	282.	1.01	21.30	86	.02	.01	.01	191.
1.01	9.45	39	.05	.04	.01	307.	1.01	21.45	87	.02	.01	.01	176.
1.01	10.00	40	.10	.09	.01	335.	1.01	22.00	88	.02	.01	.01	166.
1.01	10.15	41	.10	.09	.01	372.	1.01	22.15	89	.02	.01	.01	155.
1.01	10.30	42	.10	.09	.01	414.	1.01	22.30	90	.02	.01	.01	145.
1.01	10.45	43	.10	.09	.01	462.	1.01	22.45	91	.02	.01	.01	135.
1.01	11.00	44	.10	.09	.01	518.	1.01	23.00	92	.02	.01	.01	126.
1.01	11.15	45	.15	.14	.01	594.	1.01	23.15	93	.02	.01	.01	118.
1.01	11.30	46	.20	.19	.01	659.	1.01	23.30	94	.02	.01	.01	110.
1.01	11.45	47	.35	.34	.01	753.	1.01	23.45	95	.02	.01	.01	107.
1.01	12.00	48	.69	.68	.01	842.	1.02	0.00	96	.02	.01	.01	105.
									SUM	7.12	5.73	1.39	73347.
										(181.)(	145.)(	35.)(	2008.40)

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	4351.	2467.	766.	768.	72995.
CMS	123.	70.	22.	22.	2067.
INCHES		4.59	5.66	5.66	5.66
MM		116.60	143.73	143.73	143.73
AC-FT		1224.	1508.	1508.	1508.
THOUS CU M		1539.	1860.	1860.	1860.

HYDROGRAPH AT STA 1 FOR PLAN 1, RTIO 4

5.	4.	4.	4.	4.	3.	3.	3.	3.	2.
2.	2.	2.	2.	2.	2.	2.	1.	1.	1.
1.	1.	1.	1.	2.	4.	10.	21.	37.	63.
84.	110.	149.	179.	207.	233.	258.	282.	307.	335.
372.	414.	462.	510.	564.	659.	753.	892.	1140.	1534.
2031.	2635.	3247.	3838.	4195.	4351.	4337.	4174.	3964.	3559.
3149.	2733.	2301.	2006.	1831.	1615.	1410.	1244.	1037.	970.
865.	774.	690.	635.	580.	530.	482.	435.	390.	348.
319.	276.	246.	220.	205.	191.	178.	166.	155.	145.
135.	126.	118.	110.	107.	105.				

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	4351.	2467.	768.	763.	72995.
CMS	123.	70.	22.	22.	2067.
INCHES		4.59	5.66	5.66	5.66
MM		116.63	143.73	143.73	143.73
AC-FT		1224.	1508.	1508.	1508.
THOUS CU M		1509.	1860.	1860.	1860.

********** ********** ********** ********** **********

HYDROGRAPH ROUTING

ROUTED FLOWS THROUGH RESERVOIR

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
2	1	0	0	0	0	1	0	0

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	1	0	0	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	48.	0

CAPACITY=	0.	5.	14.	26.	48.	100.	140.	253.	540.
ELEVATION=	51.	54.	55.	56.	57.	59.	60.	62.	65.

CREL	SPWID	COQW	EXPW	ELEVL	COQL	CAREA	EXPL
56.5	83.0	2.6	1.5	0.0	0.0	0.0	0.0

DAM DATA

TOPEL	COQD	EXPD	DAMWID
58.5	2.6	1.5	418.

STATION 2, PLAN 1, RATIO 4

END-OF-PERIOD HYDROGRAPH ORDINATES

OUTFLOW

0.	0.	0.	0.	0.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	2.	2.	4.	8.
14.	24.	39.	59.	82.	109.	137.	166.	196.	226.
259.	294.	333.	370.	420.	487.	556.	658.	894.	1239.
1579.	2992.	2733.	3376.	3799.	4119.	4273.	4261.	4139.	3894.
3522.	3095.	2602.	2349.	2969.	1829.	1623.	1434.	1271.	1093.
957.	856.	774.	786.	649.	637.	574.	537.	498.	456.
423.	383.	348.	316.	298.	265.	244.	226.	210.	190.
193.	171.	160.	149.	141.	133.				

STORAGE

40.	40.	40.	40.	40.	40.	41.	41.	41.	41.
41.	41.	41.	41.	41.	41.	41.	41.	41.	41.
41.	41.	41.	41.	41.	41.	41.	41.	42.	43.
44.	46.	49.	50.	53.	55.	58.	63.	64.	65.
67.	69.	72.	75.	78.	81.	85.	90.	95.	130.
108.	119.	131.	143.	149.	155.	158.	158.	155.	150.
143.	135.	129.	123.	118.	113.	109.	105.	101.	99.
96.	94.	92.	91.	89.	89.	86.	84.	82.	80.
77.	75.	73.	71.	69.	67.	66.	65.	64.	62.
61.	61.	63.	59.	58.	57.				

STAGE

56.5	56.5	56.5	56.5	56.5	56.5	56.5	56.5	56.5	56.5
56.5	56.5	56.5	56.5	56.5	56.5	56.5	56.5	56.5	56.5
56.5	56.5	56.5	56.5	56.5	56.5	56.5	56.5	56.6	56.6
56.7	56.7	56.8	56.9	57.0	57.1	57.2	57.3	57.4	57.5
57.6	57.7	57.9	58.0	58.1	58.2	58.4	58.6	58.8	58.6
59.2	59.5	59.7	60.0	60.2	60.3	60.3	60.3	60.3	60.2
60.1	59.9	59.7	59.6	59.4	59.3	59.2	59.1	59.0	58.9
58.9	58.7	58.7	58.6	58.6	58.5	58.4	58.3	58.2	58.2
58.1	58.0	57.9	57.8	57.7	57.6	57.6	57.5	57.5	57.4
57.4	57.4	57.3	57.3	57.3	57.2				

PEAK OUTFLOW IS 4273. AT TIME 14.25 HOURS

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	4273.	2466.	752.	752.	72155.
CMS	121.	70.	21.	21.	2043.
INCHES		4.59	5.59	5.59	5.59
MM		116.25	142.07	142.07	142.07
AC-FT		1220.	1491.	1491.	1491.
THOUS CU M		1505.	1839.	1839.	1839.

HYDROGRAPH ROUTING

CHANNEL ROUTING -MODIFIED PULS- STATION 2 TO 3

```
              ISTAQ   ICOMP   IECON   ITAPE    JPLT    JPRT   INAME  ISTAGE   IAUTO
                  3       1       0       6       0       0       1       0       0
                                   ROUTING DATA
      QLOSS   CLOSS     AVG    IRES   ISAME    IOPT    IPMP            LSTR
        0.0   0.000    0.00       1       1       0       0               0

              NSTPS   NSTDL     LAG   AMSKK       X     TSK   STORA  ISPRAT
                  0100000000      0   0.000   0.000   0.000      0.       0
```

NORMAL DEPTH CHANNEL ROUTING

```
     QN(1)   QN(2)   QN(3)   ELNVT   ELMAX   RLNTH     SEL
     .0500   .0450   .0500    49.0    80.0   1000.  .00100

     CROSS SECTION COORDINATES--STA,ELEV,STA,ELEV--ETC
        0.00   49.00 1500.00   60.00 1600.00   54.00 1600.00   49.00 1625.00   49.00
     1625.00   54.00 2000.00   60.00 2200.00   80.00

STORAGE      0.00       .94      1.67      2.81      5.42     11.04     22.07     36.19     55.34     79.99
           118.14    145.48    196.95    233.63    265.75    343.41    406.56    475.21    549.36    62?.??

OUTFLOW      0.00     54.54    161.03    296.34    534.01   1209.57   2145.70   3816.90   6312.73   93??.?3
         14833.55  21176.30  29999.25  38769.33  50323.69  63931.23  79635.16  976??.?3 116?88.52 14?357.25

  STAGE     49.00     50.63     52.26     53.89     55.53     57.16     58.79     60.42     62.05     63.68
            65.32     66.95     68.58     70.21     71.84     73.47     75.11     76.74     78.37     80.00

   FLOW      0.00     54.54    151.00    296.34    534.01   1049.57   2145.70   3816.93   6312.73   93??.13
         14833.55  21170.39  29999.25  38769.33  50323.69  63931.23  79635.16  97655.93 116?88.52 141657.25
```

D-17

STATION 3, PLAN 1, RTIO 4

OUTFLOW

0.	0.	0.	0.	0.	0.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	1.	2.	3.	5.
9.	17.	29.	44.	68.	98.	125.	154.	186.	216.
248.	282.	315.	354.	491.	456.	519.	602.	760.	1056.
1417.	1849.	2447.	3114.	3435.	3999.	4225.	4273.	4172.	3953.
3656.	3273.	2850.	2482.	2141.	1939.	1710.	1521.	1347.	1177.
1026.	913.	829.	744.	681.	631.	593.	557.	519.	479.
449.	402.	366.	333.	303.	273.	251.	232.	215.	200.
187.	175.	163.	154.	144.	136.				

STOR

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	1.	1.	1.	2.	2.	2.	2.
2.	3.	3.	3.	4.	5.	5.	6.	8.	11.
15.	19.	25.	30.	35.	38.	39.	40.	39.	37.
35.	32.	28.	25.	22.	20.	18.	16.	14.	13.
11.	10.	9.	8.	7.	7.	6.	6.	5.	5.
4.	4.	4.	3.	3.	3.	2.	2.	2.	2.
2.	2.	2.	2.	2.	2.				

STAGE

49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0
49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0
49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.1	49.1	49.2
49.3	49.5	49.8	50.3	50.8	51.3	51.7	52.2	52.6	52.9
53.3	53.7	54.3	54.3	54.6	55.0	55.4	55.7	56.2	57.0
57.7	58.3	59.1	59.7	60.2	60.5	60.7	60.7	60.7	60.5
60.3	59.9	59.5	59.1	58.8	58.5	58.1	57.8	57.6	57.3
57.9	56.6	56.4	56.1	56.0	55.8	55.7	55.6	55.4	55.2
54.9	54.6	54.4	54.1	53.9	53.6	53.3	53.1	52.9	52.7
52.6	52.4	52.3	52.1	52.0	51.9				

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	4273.	2459.	751.	751.	72975.
CMS	121.	70.	21.	21.	2341.
INCHES		4.57	5.59	5.59	5.59
MM		116.19	141.91	141.91	141.91
AC-FT		1219.	1489.	1489.	1489.
THOUS CU M		1504.	1837.	1837.	1837.

MAXIMUM STORAGE = 40.

MAXIMUM STAGE IS 60.7

HYDROGRAPH ROUTING

CHANNEL ROUTING -MODIFIED PULS- STATION 3 TO 4

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
4	1	0	0	0	0	1	0	0

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP		LSTR
0.0	0.000	0.00	1	1	0	0		0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
0	0000000	0	0.000	0.000	0.000	0.	0

NORMAL DEPTH CHANNEL ROUTING

QN(1)	QN(2)	QN(3)	ELNVT	ELMAX	RLNTH	SEL
.0500	.0450	.0500	46.0	80.0	4300.	.00100

CROSS SECTION COORDINATES--STA,ELEV,STA,ELEV--ETC

```
  0.00   80.00  900.00   63.00 1100.00   49.00 1100.00   46.00 1125.00   46.00
1125.00  49.00 1250.00   63.00 1900.00   80.00
```

STORAGE	0.00	5.03	10.62	24.42	48.06	83.94	129.67	186.33	253.3[illegible]	342.0[illegible]
	459.96	605.00	770.16	979.17	1200.09	1464.92	1749.60	2062.3[illegible]	[illegible]	[illegible]
OUTFLOW	0.00	63.15	191.95	460.55	994.34	1831.10	3235.31	5103.32	7412.07	[illegible]
	13856.03	19994.97	25874.00	34364.57	44725.06	57117.30	71091.69	86590.44	107961.75	[illegible]
STAGE	46.09	47.79	49.58	51.37	53.16	54.95	56.74	[illegible]	[illegible]	62.11
	63.89	65.60	67.47	69.26	71.05	72.84	74.63	76.42	78.21	[illegible]
FLOW	0.09	63.15	191.95	460.55	994.34	1841.10	3235.31	5103.32	7412.07	[illegible]
	13856.03	19894.90	25474.00	34364.57	44725.00	57117.00	71091.69	86590.44	107961.75	[illegible]

AD-A069 219 NEW JERSEY STATE DEPT OF ENVIRONMENTAL PROTECTION TRENTON F/G 13/2
NATIONAL DAM SAFETY PROGRAM. LAKE NELSON DAM (NJ 00376). RARITA--ETC(U)
MAY 79 R J JENNY DACW61-78-C-0124

UNCLASSIFIED NL

2 OF 2
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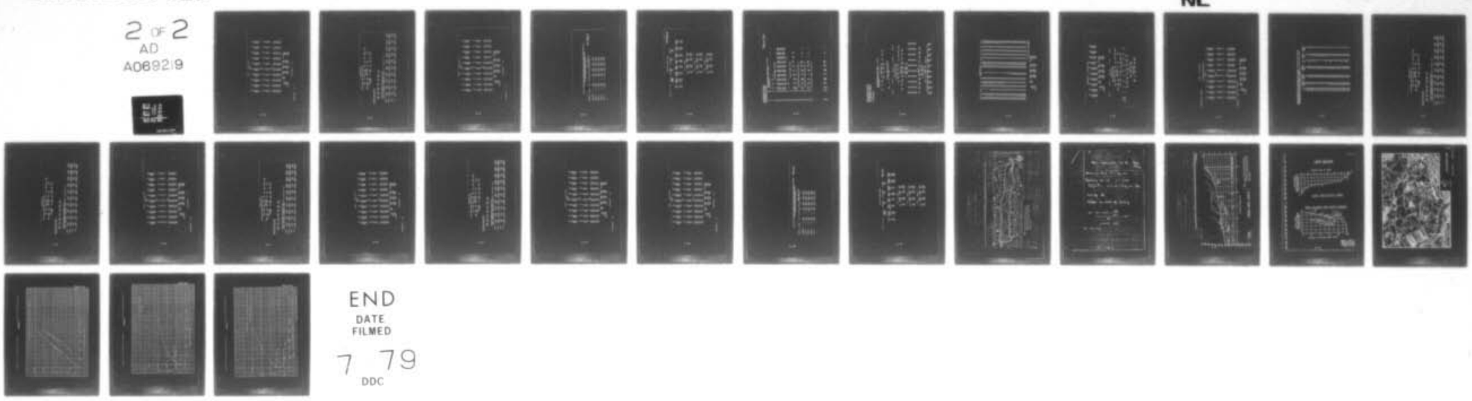
A069219



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DATE
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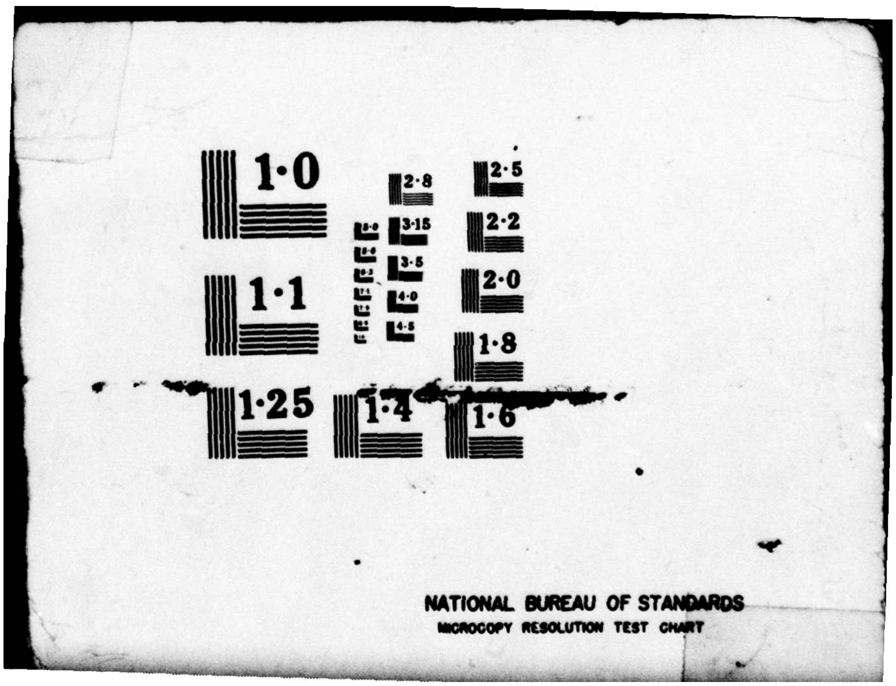
7 79
DDC


1·0
2·8
2·5
3·15
2·2
3·5
2·0
1·1
4·0
4·5
1·8
1·25
1·4
1·6
NATIONAL BUREAU OF STANDARDS
MICROCOPY RESOLUTION TEST CHART

STATION 4, PLAN 1, RTIC 4

OUTFLOW

0.	0.	0.	0.	0.	0.	0.	0.	0.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	2.	2.
3.	6.	9.	16.	25.	38.	55.	82.	116.	148.
189.	210.	249.	272.	337.	348.	395.	450.	535.	673.
879.	1173.	1504.	2186.	2637.	3213.	3673.	3967.	4397.	4003.
3929.	3697.	3373.	3032.	2705.	2405.	2136.	1896.	1702.	1510.
1344.	1190.	1054.	947.	861.	785.	721.	660.	620.	576.
533.	492.	453.	410.	385.	352.	322.	295.	271.	253.
231.	214.	199.	185.	171.	159.				

STOR

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	1.	1.	2.	3.	4.	6.	7.	9.
10.	12.	13.	15.	17.	19.	21.	24.	28.	34.
44.	56.	72.	91.	111.	129.	143.	152.	156.	155.
151.	144.	134.	123.	112.	101.	92.	84.	77.	69.
63.	56.	51.	47.	43.	39.	36.	34.	32.	30.
29.	26.	24.	22.	21.	19.	17.	16.	15.	14.
13.	12.	11.	10.	10.	9.				

STAGE

46.0	46.0	46.0	46.0	46.0	46.0	46.0	46.0	46.0	46.0
46.0	46.0	46.0	46.0	46.0	46.0	46.0	46.0	46.0	46.0
46.0	46.0	46.0	46.0	46.0	46.0	46.0	46.0	46.0	46.1
46.1	46.2	46.3	46.4	46.7	47.1	47.6	48.0	48.5	49.0
49.4	49.7	49.9	50.1	50.3	50.6	50.9	51.3	51.6	52.1
52.8	53.5	54.3	55.2	56.0	56.7	57.2	57.4	57.6	57.5
57.4	57.2	56.9	56.5	56.1	55.6	55.3	55.0	54.6	54.2
53.9	53.5	53.3	53.0	52.7	52.5	52.2	52.1	51.9	51.8
51.6	51.5	51.3	51.1	50.9	50.6	50.4	50.3	50.1	50.0
49.8	49.7	49.6	49.5	49.3	49.1				

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	4397.	2434.	746.	746.	71633.
CMS	116.	69.	21.	21.	2028.
INCHES		4.53	5.55	5.55	5.55
MM		115.00	141.04	141.04	141.04
AC-FT		1207.	1480.	1480.	1480.
THOUS CU M		1489.	1825.	1825.	1825.

MAXIMUM STORAGE = 156.

MAXIMUM STAGE IS 57.6

HYDROGRAPH ROUTING

CHANNEL ROUTING -MODIFIED PULS- STATION 4 TO 5

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
5	1	0	6	0	0	1	0	0

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP		LSTR
0.0	0.000	0.00	1	1	0	0		0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
6	13000000	0	0.000	0.000	0.000	0.	0

NORMAL DEPTH CHANNEL ROUTING

QN(1)	QN(2)	QN(3)	ELNVT	ELMAX	RLNTH	SEL
.0500	.0459	.0500	40.0	80.0	8700.	.00100

CROSS SECTION COORDINATES--STA,ELEV,STA,ELEV--ETC

0.00	49.03	1803.99	63.30	2300.00	43.90	2300.00	40.00	2325.06	40.60
2325.00	47.93	2306.00	63.39	4330.90	89.00				

STORAGE	0.60	19.51	37.16	152.03	365.73	676.40	1084.03	1590.43	2199.40	2995.73
	3695.79	4660.02	5412.17	6729.74	7953.54	9283.56	10719.01	[illegible]	[illegible]	[illegible]
OUTFLOW	9.09	81.60	323.40	1209.67	3759.12	8207.77	15360.21	25297.30	38007.51	55797.32
	76850.29	102610.53	133477.43	169770.22	211024.82	259936.00	314433.29	375622.47	443024.29	519333.92
STAGE	40.09	42.11	44.21	46.32	48.42	50.53	52.63	54.74	56.84	58.95
	61.05	63.16	65.26	67.37	69.47	71.58	73.60	75.79	77.89	[illegible]
FLOW	9.09	81.60	323.40	1209.67	3759.12	8267.77	15360.21	25297.30	38007.51	55797.32
	76890.24	102610.53	133477.43	163770.22	211024.02	259936.00	314438.29	375622.07	443024.29	519333.92

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STATION 5, PLAN 1, RTIO 4

OUTFLOW

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	2.	3.	4.	7.	10.	16.	23.	35.	49.
66.	86.	118.	131.	156.	183.	213.	246.	285.	337.
400.	509.	650.	844.	1396.	1433.	1863.	2202.	2650.	2962.
3106.	3321.	3367.	3332.	3233.	3080.	2913.	2721.	2524.	2329.
2137.	1951.	1773.	1600.	1457.	1322.	1222.	1136.	1356.	962.
915.	840.	787.	738.	677.	627.	580.	536.	495.	457.
422.	390.	360.	333.	307.	285.				

STOR

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	1.	1.	1.	2.	3.	4.	6.
9.	11.	14.	16.	19.	23.	26.	30.	35.	41.
49.	61.	79.	100.	130.	165.	202.	230.	271.	297.
316.	320.	332.	329.	320.	308.	293.	276.	259.	242.
226.	219.	194.	180.	167.	155.	145.	135.	125.	117.
108.	101.	94.	87.	82.	75.	70.	64.	60.	55.
51.	47.	44.	41.	38.	35.				

STAGE

40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0
40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0
40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.6
40.0	40.0	40.1	40.1	40.2	40.3	40.4	40.6	40.9	41.3
41.7	42.1	42.4	42.6	42.8	43.1	43.4	43.7	44.0	44.3
44.4	44.6	45.0	45.4	45.9	46.4	46.8	47.2	47.5	47.7
47.9	48.0	48.1	48.1	48.0	47.8	47.7	47.5	47.4	47.2
47.0	46.9	46.7	46.6	46.5	46.3	46.2	46.6	45.8	45.7
45.5	45.4	45.2	45.1	45.0	44.9	44.8	44.7	44.6	44.5
44.5	44.4	44.3	44.3	44.2	44.8				

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	3367.	2207.	724.	729.	69939.
CMS	95.	65.	21.	21.	1980.
INCHES		4.25	5.42	5.42	5.42
MM		108.00	137.71	137.71	137.71
AC-FT		1134.	1445.	1445.	1445.
THOUS CU M		1399.	1782.	1782.	1782.

MAXIMUM STORAGE = 332.

MAXIMUM STAGE IS 48.1

PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
AREA IN SQUARE MILES (SQUARE KILOMETERS)

No Breach

OPERATION	STATION	AREA	PLAN	RATIO 1 .10	RATIO 2 .25	RATIO 3 .50	RATIO 4 1.00
				RATIOS APPLIED TO FLOWS			
HYDROGRAPH AT	1	5.00	1	435.	1088.	2175.	4351.
	(	12.95)	(	12.32)(	30.80)(	61.60)(	123.20)(
ROUTED TO	2	5.00	1	372.	1068.	2137.	4273.
	(	12.95)	(	10.53)(	30.24)(	60.51)(	121.00)(
ROUTED TO	3	5.00	1	372.	1064.	2135.	4273.
	(	12.95)	(	10.54)(	30.14)(	60.45)(	121.00)(
ROUTED TO	4	5.00	1	344.	951.	2009.	4107.
	(	12.95)	(	9.74)(	26.94)(	56.90)(	116.33)(
ROUTED TO	5	5.00	1	275.	726.	1578.	3367.
	(	12.95)	(	7.77)(	20.56)(	44.69)(	95.34)(

No Breach

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 ....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	56.50	56.50	58.53
STORAGE	40.	40.	66.
OUTFLOW	0.	0.	610.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.10	57.96	0.00	75.	372.	0.00	15.00	0.00
.25	58.93	.40	90.	1060.	2.59	14.25	0.00
.50	59.40	.90	119.	2137.	4.50	14.25	0.00
1.00	60.34	1.84	154.	4273.	7.00	14.25	0.00

PLAN 1 STATION 3

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.10	372.	54.4	15.00
.25	1064.	57.1	14.50
.50	2135.	59.0	14.50
1.00	4273.	60.7	14.56

PLAN 1 STATION 4

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.10	344.	52.6	15.50
.25	953.	53.8	15.25
.50	2009.	55.1	15.03
1.00	4037.	57.6	14.75

PLAN 1 STATION 5

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.10	275.	43.9	16.75
.25	726.	45.1	16.25
.50	1576.	46.6	16.00
1.00	3367.	48.1	15.75

Breach Calc.

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*************************************
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION        JULY 1978
  LAST MODIFICATION  25 SEP 78
*************************************
   1         A1     NEW JERSEY DAM SAFETY - LAKE NELSON DAM  I.D. NO 00376
   2         A2     HYDRAULIC-HYDROLOGIC ANALYSIS   302-03
   3         A3     100 YEAR FLOOD
   4         B       96       0      15       0       0       0       0       0       0       0
   5         B1       5
   6         J        1       4       1
   7         J1     0.1    0.25    0.50    1.00
   8         K        0       1                                       1
   9         K1                             INFLOW HYDROGRAPH TO RESERVOIR
  10         M        0       2     5.0             5.0                               1
  11         P       96
  12         QI    0.02    0.02    0.02    0.02    0.02    0.02    0.02    0.02    0.02    0.02
  13         QI    0.02    0.02    0.02    0.02    0.02    0.02    0.02    0.02    0.02    0.02
  14         QI    0.02    0.02    0.02    0.02    0.04    0.04    0.04    0.04    0.04    0.04
  15         QI    0.04    0.04    0.04    0.04    0.04    0.04     0.1    0.05    0.05     0.1
  16         QI     0.1     0.1     0.1     0.1    0.15     0.2    0.35    0.69    1.64    0.42
  17         QI     0.2    0.15     0.1    0.15     0.1    0.05     0.1    0.05     0.1    0.05
  18         QI    0.04    0.04    0.04    0.04    0.04    0.04    0.04    0.04    0.04    0.04
  19         QI    0.04    0.04    0.02    0.02    0.02    0.02    0.02    0.02    0.02    0.02
  20         QI    0.02    0.02    0.02    0.02    0.02    0.02    0.02    0.02    0.02    0.02
  21         QI    0.02    0.02    0.02    0.02    0.02    0.02
  22         T                                                    0.5    0.05
  23         W2             2.0
  24         X       -1    -.05     2.0
  25         K        1       2                                       1
  26         K1                             ROUTED FLOWS THROUGH RESERVOIR
  27         Y                               1       1
  28         Y1       1                                              40
  29         $A       0       5      14      26      40     100     140     290     520
  30         $E    90.9    93.5    94.5    95.5    96.5      99      60      62      65
  31         $S    96.5      83     2.6     1.5
  32         $D    98.5     2.6     1.5     410
  33         $B     410       1    93.5       2    96.5    98.5
  34         K        1       3                                       1
  35         K1         CHANNEL ROUTING -MODIFIED PULS- STATION 2 TO 3
  36         Y                               1       1
  37         Y1       1
  38         Y6    0.05   0.045    0.05      49      80    1000   0.001
  39         Y7       0      90    1600      60    1000      94    1000      49    1025      49
  40         Y7    1025      94    2000      60    2200      80
  41         K        1       4                                       1
  42         K1         CHANNEL ROUTING -MODIFIED PULS- STATION 3 TO 4
  43         Y                               1       1
  44         Y1       1
  45         Y6    0.05   0.045    0.05      46      80    4900   0.001
  46         Y7       0      80     900      60    1100      49    1100      46    1125      46
  47         Y7    1125      49    1250      60    1900      80
  48         K        1       5                                       1
  49         K1         CHANNEL ROUTING -MODIFIED PULS- STATION 4 TO 5
  50         Y                               1       1

  51         Y1       1
  52         Y6    0.07   0.045    0.05      40      80    8760   0.001
  53         Y7       0      40    1000      60    2360      43    2360      40    2325      40
  54         Y7    2325      43    2400      60    4300      80
  55         K       99
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****************************************
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION      JULY 1978
 LAST MODIFICATION  25 SEP 78
****************************************

RUN  DATED 01/15/79
     TIMED 08.29.56.


            NEW JERSEY DAM SAFETY - LAKE NELSON DAM  I.D. NO 00376
            HYDRAULIC-HYDROLOGIC ANALYSIS   302-03
            100 YEAR FLOOD

                              JOB SPECIFICATION
      NQ     NHR    NMIN    IDAY     IHR    IMIN   METRC    IPLT    IPRT   NSTAN
      96       0      15       0       0       0       0       0       0       0
                            JOPER    NWT   LROPT   TRACE
                               5       0       0       0

                     MULTI-PLAN ANALYSES TO BE PERFORMED
                        NPLAN= 1 NRTIO= 4 LRTIO= 1
      RTIOS=     .10     .25     .50    1.00

     *********     *********     *********     *********     *********

                        SUB-AREA RUNOFF COMPUTATION

                        INFLOW HYDROGRAPH TO RESERVOIR

               ISTAQ   ICOMP   IECON   ITAPE    JPLT    JPRT   INAME  ISTAGE   IAUTO
                   1       0       0       0       0       0       1       0       0

                               HYDROGRAPH DATA
      IHYDG   IUHG   TAREA    SNAP   TRSDA   TRSPC   RATIO   ISNOW   ISAME   LOCAL
          0      2    5.03    0.00    5.00    0.00   0.000       0       1       0

                                 PRECIP DATA
                          NP   STORM     DAJ     DAK
                          96    0.00    0.00    0.00
                               PRECIP PATTERN
        .02     .02     .02     .02     .02     .02     .02     .02     .02     .02
        .02     .02     .02     .02     .02     .02     .02     .02     .02     .02
        .02     .02     .02     .02     .04     .04     .04     .04     .04     .04
        .04     .04     .04     .04     .04     .04     .10     .05     .05     .10
        .10     .10     .10     .10     .15     .20     .35     .69    1.64     .42
        .20     .15     .10     .15     .10     .05     .10     .05     .10     .05
        .04     .04     .04     .04     .04     .04     .04     .04     .04     .04
        .04     .04     .02     .02     .02     .02     .02     .02     .02     .02
        .02     .02     .02     .02     .02     .02     .02     .02     .02     .02
        .02     .02     .02     .02     .02     .02

                                  LOSS DATA
      LROPT  STRKR   DLTKR   RTIOL   ERAIN   STRKS   RTIOK   STRTL   CNSTL   ALSMX   RTIMP
          0   0.00    0.00    1.00    0.00    0.00    1.00     .50     .05    0.00    0.00

                             UNIT HYDROGRAPH DATA
                          TC=  0.00     LAG=  2.00

                                RECESSION DATA
                   STRTQ=   -1.00    QRCSN=    -.05    RTIOR= 2.00

       UNIT HYDROGRAPH 42 END OF PERIOD ORDINATES, TC=    0.00 HOURS, LAG=   2.00  VOL= 1.00
        48.    190.    284.    480.    724.    939.   1072.   1120.   1129.   1072.
       981.    872.    732.    583.    471.    387.    316.    269.    223.    183.
       151.    124.    103.     85.     70.     57.     47.     40.     32.     27.
        22.     18.     15.     12.     11.      9.      8.      6.      5.      3.
         2.      1.
```

END-OF-PERIOD FLOW

MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q	MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q
1.01	.15	1	.02	0.00	.02	5.	1.01	12.15	49	1.64	1.63	.01	1140.
1.01	.30	2	.02	0.00	.02	4.	1.01	12.30	50	.42	.41	.01	1534.
1.01	.45	3	.02	0.00	.02	4.	1.01	12.45	51	.20	.19	.01	2031.
1.01	1.00	4	.02	0.00	.02	4.	1.01	13.00	52	.15	.14	.01	2635.
1.01	1.15	5	.02	0.00	.02	4.	1.01	13.15	53	.10	.09	.01	3287.
1.01	1.30	6	.02	0.00	.02	3.	1.01	13.30	54	.15	.14	.01	3638.
1.01	1.45	7	.02	0.00	.02	3.	1.01	13.45	55	.10	.09	.01	4195.
1.01	2.00	8	.02	0.00	.02	3.	1.01	14.00	56	.05	.04	.01	4351.
1.01	2.15	9	.02	0.00	.02	3.	1.01	14.15	57	.10	.09	.01	4337.
1.01	2.30	10	.02	0.00	.02	3.	1.01	14.30	58	.05	.04	.01	4174.
1.01	2.45	11	.02	0.00	.02	2.	1.01	14.45	59	.10	.09	.01	3904.
1.01	3.00	12	.02	0.00	.02	2.	1.01	15.00	60	.05	.04	.01	3559.
1.01	3.15	13	.02	0.00	.02	2.	1.01	15.15	61	.04	.03	.01	3147.
1.01	3.30	14	.02	0.00	.02	2.	1.01	15.30	62	.04	.03	.01	2733.
1.01	3.45	15	.02	0.00	.02	2.	1.01	15.45	63	.04	.03	.01	2381.
1.01	4.00	16	.02	0.00	.02	2.	1.01	16.00	64	.04	.03	.01	2085.
1.01	4.15	17	.02	0.00	.02	2.	1.01	16.15	65	.04	.03	.01	1831.
1.01	4.30	18	.02	0.00	.02	1.	1.01	16.30	66	.04	.03	.01	1615.
1.01	4.45	19	.02	0.00	.02	1.	1.01	16.45	67	.04	.03	.01	1419.
1.01	5.00	20	.02	0.00	.02	1.	1.01	17.00	68	.04	.03	.01	1244.
1.01	5.15	21	.02	0.00	.02	1.	1.01	17.15	69	.04	.03	.01	1097.
1.01	5.30	22	.02	0.00	.02	1.	1.01	17.30	70	.04	.03	.01	970.
1.01	5.45	23	.02	0.00	.02	1.	1.01	17.45	71	.04	.03	.01	865.
1.01	6.00	24	.02	0.00	.02	1.	1.01	18.00	72	.04	.03	.01	774.
1.01	6.15	25	.04	.01	.03	2.	1.01	18.15	73	.02	.01	.01	690.
1.01	6.30	26	.04	.03	.01	4.	1.01	18.30	74	.02	.01	.01	635.
1.01	6.45	27	.04	.03	.01	10.	1.01	18.45	75	.02	.01	.01	590.
1.01	7.00	28	.04	.03	.01	21.	1.01	19.00	76	.02	.01	.01	533.
1.01	7.15	29	.04	.03	.01	37.	1.01	19.15	77	.02	.01	.01	482.
1.01	7.30	30	.04	.03	.01	60.	1.01	19.30	78	.02	.01	.01	435.
1.01	7.45	31	.04	.03	.01	86.	1.01	19.45	79	.02	.01	.01	390.
1.01	8.00	32	.04	.03	.01	116.	1.01	20.00	80	.02	.01	.01	349.
1.01	8.15	33	.04	.03	.01	149.	1.01	20.15	81	.02	.01	.01	313.
1.01	8.30	34	.04	.03	.01	179.	1.01	20.30	82	.02	.01	.01	276.
1.01	8.45	35	.04	.03	.01	207.	1.01	20.45	83	.02	.01	.01	246.
1.01	9.00	36	.04	.03	.01	233.	1.01	21.00	84	.02	.01	.01	223.
1.01	9.15	37	.10	.09	.01	258.	1.01	21.15	85	.02	.01	.01	205.
1.01	9.30	38	.09	.08	.01	282.	1.01	21.30	86	.02	.01	.01	191.
1.01	9.45	39	.09	.08	.01	307.	1.01	21.45	87	.02	.01	.01	178.
1.01	10.00	40	.10	.09	.01	335.	1.01	22.00	88	.02	.01	.01	166.
1.01	10.15	41	.10	.09	.01	372.	1.01	22.15	89	.02	.01	.01	155.
1.01	10.30	42	.10	.09	.01	414.	1.01	22.30	90	.02	.01	.01	145.
1.01	10.45	43	.10	.09	.01	462.	1.01	22.45	91	.02	.01	.01	135.
1.01	11.00	44	.10	.09	.01	518.	1.01	23.00	92	.02	.01	.01	126.
1.01	11.15	45	.15	.14	.01	584.	1.01	23.15	93	.02	.01	.01	118.
1.01	11.30	46	.20	.19	.01	659.	1.01	23.30	94	.02	.01	.01	110.
1.01	11.45	47	.35	.34	.01	753.	1.01	23.45	95	.02	.01	.01	107.
1.01	12.00	48	.69	.68	.01	892.	1.02	0.00	96	.02	.01	.01	105.
									SUM	7.12	5.73	1.39	73647.
										(181.)(	145.)(	35.)(	2084.46)

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	4351.	2467.	766.	760.	72995.
CMS	123.	70.	22.	22.	2067.
INCHES		4.59	5.66	5.66	5.66
MM		116.60	143.73	143.73	143.73
AC-FT		1224.	1508.	1508.	1508.
THOUS CU M		1509.	1860.	1860.	1860.

HYDROGRAPH AT STA 1 FOR PLAN 1, RTIO 4

5.	4.	4.	4.	4.	3.	3.	3.	3.	2.
2.	2.	2.	2.	2.	2.	2.	1.	1.	1.
1.	1.	1.	1.	2.	4.	10.	21.	37.	60.
88.	118.	149.	179.	207.	233.	258.	282.	307.	335.
372.	414.	462.	518.	584.	659.	753.	892.	1143.	1534.
2031.	2635.	3287.	3838.	4195.	4351.	4337.	4474.	3904.	3559.
3149.	2733.	2301.	2086.	1831.	1615.	1410.	1244.	1097.	970.
865.	774.	698.	635.	586.	530.	482.	435.	390.	348.
310.	276.	246.	220.	205.	191.	178.	166.	155.	145.
135.	126.	118.	110.	107.	105.				

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	4351.	2467.	760.	760.	72995.
CMS	123.	70.	22.	22.	2067.
INCHES		4.59	5.66	5.66	5.66
MM		116.60	143.73	143.73	143.73
AC-FT		1224.	1508.	1508.	1508.
THOUS CU M		1509.	1860.	1860.	1860.

********** ********** ********** ********** **********

HYDROGRAPH ROUTING

ROUTED FLOWS THROUGH RESERVOIR

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
2	1	0	0	0	0	1	0	0

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	1	0	0	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	40.	0

CAPACITY=	0.	5.	14.	26.	40.	100.	140.	250.	520.
ELEVATION=	51.	54.	55.	56.	57.	59.	60.	62.	65.

CRFL	SPWID	COQW	EXPW	ELEVL	COQL	CAREA	EXPL
56.5	83.0	2.6	1.5	0.6	0.0	0.0	0.0

DAM DATA

TOPEL	COQD	EXPD	DAMWID
58.5	2.6	1.5	410.

DAM BREACH DATA

BRWID	Z	ELBM	TFAIL	WSEL	FAILEL
410.	1.00	50.50	2.00	56.50	58.50

STATION 2, PLAN 1, RATIO 4

BEGIN DAM FAILURE AT 12.90 HOURS

END-OF-PERIOD HYDROGRAPH ORDINATES

OUTFLOW

0.	0.	0.	0.	0.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	2.	2.	4.	8.
14.	24.	39.	59.	82.	109.	137.	166.	196.	226.
258.	294.	333.	378.	428.	487.	556.	671.	1674.	2297.
2041.	3429.	3006.	4307.	4578.	4429.	4338.	4182.	3912.	3572.
3162.	2747.	2391.	2096.	1839.	1624.	1425.	1251.	1102.	976.
869.	778.	702.	639.	583.	533.	484.	438.	393.	351.
313.	278.	248.	222.	207.	193.	180.	168.	157.	147.
137.	128.	119.	112.	107.	106.				

STORAGE

40.	40.	40.	40.	40.	40.	41.	41.	41.	41.
41.	41.	41.	41.	41.	41.	41.	41.	41.	41.
41.	41.	41.	41.	41.	41.	41.	41.	42.	43.
44.	46.	48.	50.	53.	55.	58.	60.	63.	65.
67.	69.	72.	75.	78.	81.	85.	89.	86.	72.
56.	39.	27.	17.	8.	4.	4.	4.	4.	3.
3.	3.	3.	2.	2.	2.	2.	2.	2.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.				

STAGE

56.5	56.5	56.5	56.5	56.5	56.5	56.5	56.5	56.5	56.5
56.5	56.5	56.5	56.5	56.5	56.5	56.5	56.5	56.5	56.5
56.5	56.5	56.5	56.5	56.5	56.5	56.5	56.5	56.6	56.6
56.7	56.7	56.8	56.9	57.0	57.1	57.2	57.3	57.4	57.5
57.6	57.7	57.9	58.6	58.1	58.2	58.4	58.6	58.4	57.8
57.2	56.4	55.6	54.8	53.9	52.8	52.8	52.7	52.6	52.5
52.3	52.2	52.0	51.9	51.8	51.7	51.6	51.5	51.4	51.3
51.3	51.2	51.2	51.1	51.1	51.1	51.0	51.0	51.0	50.9
50.9	50.9	50.8	50.8	50.8	50.8	50.8	50.8	50.7	50.7
50.7	50.7	50.7	50.7	50.7	50.7				

PEAK OUTFLOW IS 4657. AT TIME 13.83 HOURS

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	4578.	2649.	781.	781.	75019.
CMS	130.	75.	22.	22.	2124.
INCHES		4.93	5.82	5.82	5.82
MM		125.18	147.71	147.71	147.71
AC-FT		1314.	1550.	1550.	1550.
THOUS CU M		1620.	1912.	1912.	1912.

THE DAM BREACH HYDROGRAPH WAS DEVELOPED USING A TIME INTERVAL OF .042 HOURS DURING BREACH FORMATION.
DOWNSTREAM CALCULATIONS WILL USE A TIME INTERVAL OF .250 HOURS.
THIS TABLE COMPARES THE HYDROGRAPH FOR DOWNSTREAM CALCULATIONS WITH THE COMPUTED BREACH HYDROGRAPH.
INTERMEDIATE FLOWS ARE INTERPOLATED FROM END-OF-PERIOD VALUES.

TIME (HOURS)	TIME FROM BEGINNING OF BREACH (HOURS)	INTERPOLATED BREACH HYDROGRAPH (CFS)	-	COMPUTED BREACH HYDROGRAPH (CFS)	=	ERROR (CFS)	ACCUMULATED ERROR (CFS)	ACCUMULATED ERROR (AC-FT)
12.000	0.000	671.		671.		0.	0.	0.
12.042	.042	838.		827.		11.	11.	0.
12.083	.083	1005.		1017.		-12.	-0.	-0.
12.125	.125	1173.		1206.		-34.	-34.	-0.
12.167	.167	1340.		1375.		-35.	-69.	-0.
12.208	.208	1507.		1532.		-25.	-94.	-0.
12.250	.250	1674.		1674.		0.	-94.	-0.
12.292	.292	1778.		1800.		-22.	-116.	-0.
12.333	.333	1882.		1915.		-33.	-149.	-1.
12.375	.375	1986.		2020.		-34.	-183.	-1.
12.417	.417	2089.		2117.		-28.	-211.	-1.
12.458	.458	2193.		2209.		-16.	-227.	-1.
12.500	.500	2297.		2297.		-0.	-227.	-1.
12.542	.542	2387.		2384.		4.	-223.	-1.
12.583	.583	2478.		2473.		5.	-219.	-1.
12.625	.625	2569.		2564.		5.	-212.	-1.
12.667	.667	2660.		2655.		4.	-208.	-1.
12.708	.708	2750.		2748.		2.	-206.	-1.
12.750	.750	2841.		2841.		0.	-206.	-1.
12.792	.792	2939.		2938.		1.	-204.	-1.
12.833	.833	3037.		3040.		-2.	-207.	-1.
12.875	.875	3135.		3146.		-10.	-217.	-1.
12.917	.917	3233.		3255.		-21.	-238.	-1.
12.958	.958	3331.		3367.		-35.	-273.	-1.
13.000	1.000	3429.		3429.		0.	-273.	-1.
13.042	1.042	3492.		3399.		94.	-180.	-1.
13.083	1.083	3555.		3437.		119.	-61.	-0.
13.125	1.125	3618.		3509.		108.	47.	0.
13.167	1.167	3681.		3601.		80.	127.	0.
13.208	1.208	3743.		3701.		42.	170.	1.
13.250	1.250	3806.		3806.		0.	170.	1.
13.292	1.292	3890.		3894.		-4.	166.	1.
13.333	1.333	3973.		3957.		16.	181.	1.
13.375	1.375	4057.		4037.		19.	201.	1.
13.417	1.417	4140.		4125.		15.	216.	1.
13.458	1.458	4223.		4215.		8.	224.	1.
13.500	1.500	4307.		4307.		0.	224.	1.
13.542	1.542	4352.		4390.		-38.	186.	1.
13.583	1.583	4397.		4446.		-49.	138.	0.
13.625	1.625	4442.		4429.		13.	151.	1.
13.667	1.667	4488.		4467.		21.	172.	1.
13.708	1.708	4533.		4520.		13.	185.	1.
13.750	1.750	4578.		4578.		0.	185.	1.
13.792	1.792	4553.		4625.		-72.	113.	0.
13.833	1.833	4528.		4657.		-129.	-16.	-0.
13.875	1.875	4504.		4330.		174.	158.	1.
13.917	1.917	4479.		4384.		94.	252.	1.
13.958	1.958	4454.		4396.		58.	310.	1.
14.000	2.000	4429.		4429.		0.	310.	1.

```
                                   HYDROGRAPH ROUTING

              CHANNEL ROUTING -MODIFIED PULS- STATION 2 TO 3

                        ISTAQ   ICOMP   IECON   ITAPE    JPLT    JPRT   INAME  ISTAGE   IAUTO
                            3       1       0       0       0       0       1       0       0
                                                 ROUTING DATA
               QLOSS    CLOSS     AVG    IRES   ISAME    IOPT    IPMP                    LSTR
                 0.0    0.000    0.00       1       1       C       0                       0

                        NSTPS   NSTDL     LAG   AMSKK       X     TSK   STORA  ISPRAT
                            010000000       0   0.000   0.00C   0.000      0.       0
```

NORMAL DEPTH CHANNEL ROUTING

```
       QN(1)   QN(2)   QN(3)   ELNVT   ELMAX   RLNTH     SEL
       .0500   .6453   .0500    49.0    80.0   1000.  .00100

       CROSS SECTION COORDINATES--STA,ELEV,STA,ELEV--ETC
          0.00   80.00 1600.00   60.00 1900.00   54.00 1800.00   49.00 1825.00   49.00
       1825.26   54.00 2000.00   60.00 2200.00   80.00
```

STORAGE	0.03	.94	1.87	2.81	9.42	11.84	22.07	36.19	55.34	79.99
	110.14	145.80	186.95	233.63	285.75	343.41	406.56	475.21	549.36	629.C2
OUTFLOW	0.00	94.94	161.00	296.34	534.01	1089.57	2145.78	3816.98	6312.73	9934.13
	14033.55	21170.30	29099.25	38769.33	50323.89	63901.23	79635.16	97655.50	118688.52	141057.29
STAGE	49.00	50.63	52.26	53.89	55.53	57.16	58.79	60.42	62.05	63.68
	65.32	65.95	68.58	70.21	71.84	73.47	75.11	76.74	78.37	80.60
FLOW	0.00	94.94	161.00	296.34	534.01	1089.57	2145.78	3816.98	6312.73	9934.13
	14033.55	21179.30	29699.25	38769.33	50323.89	63901.23	79635.16	97655.50	118080.52	141057.29

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                              HYDROGRAPH ROUTING

            CHANNEL ROUTING -MODIFIED PULS- STATION 2 TO 3

                  ISTAQ   ICOMP   IECON   ITAPE    JPLT    JPRT   INAME  ISTAGE   IAUTO
                      3       1       0       0       0       0       1       0       0
                                          ROUTING DATA
          QLOSS   CLOSS     AVG    IRES   ISAME    IOPT    IPMP            LSTR
            0.0   0.000    0.00       1       1       0       0               0

                  NSTPS   NSTDL     LAG   AMSKK       X     TSK   STORA  ISPRAT
                      0100000000      0   0.000   0.000   0.000      0.       0

NORMAL DEPTH CHANNEL ROUTING
----------------------------

        QN(1)   QN(2)   QN(3)   ELNVT   ELMAX   RLNTH     SEL
        .0500   .0453   .0500    49.0    80.0   1000.  .00100

        CROSS SECTION COORDINATES--STA,ELEV,STA,ELEV--ETC
            0.00   80.00 1600.00   60.00 1900.00   54.00 1800.00   49.00 1825.00   49.00
         1825.00   54.00 2000.00   60.00 2200.00   80.00

  STORAGE       0.00       .94      1.87      2.81      5.42     11.04     22.07     36.10     55.34     79.90
              110.14    145.80    186.95    233.60    285.75    343.41    406.56    475.21    549.36    629.62

  OUTFLOW       0.00     54.54    161.00    296.34    534.01   1089.57   2145.78   3816.98   6312.73   9934.13
            14033.55  21170.30  29099.25  38769.33  50323.09  63901.23  79635.16  97655.50 118080.92 141057.29

    STAGE      49.00     50.63     52.26     53.89     55.53     57.16     58.79     60.42     62.05     63.68
               65.32     66.95     68.58     70.21     71.84     73.47     75.11     76.74     78.37     80.00

     FLOW       0.00     54.54    161.00    296.34    534.01   1089.57   2145.78   3816.98   6312.73   9934.13
            14033.55  21170.30  29099.25  38769.33  50323.09  63901.23  79635.16  97655.50 118080.92 141057.29
```

STATION 3, PLAN 1, RTIO 4

OUTFLOW

0.	0.	0.	0.	0.	0.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	1.	2.	3.	5.
9.	17.	20.	44.	60.	90.	125.	194.	186.	216.
240.	282.	315.	354.	402.	456.	519.	660.	1140.	2012.
2616.	3189.	3661.	4108.	4492.	4565.	4366.	4244.	4010.	3706.
3333.	2917.	2534.	2214.	1956.	1725.	1518.	1333.	1172.	1040.
929.	830.	745.	674.	614.	561.	511.	463.	417.	373.
333.	297.	257.	231.	212.	198.	185.	172.	161.	151.
141.	132.	123.	115.	109.	104.				

STOR

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	1.	1.	1.	2.	2.	2.	2.
2.	5.	3.	3.	4.	5.	5.	6.	12.	21.
26.	31.	35.	38.	41.	41.	40.	39.	38.	35.
32.	29.	25.	23.	20.	18.	16.	14.	13.	11.
10.	9.	8.	7.	6.	6.	5.	5.	4.	4.
3.	3.	3.	2.	2.	2.	2.	2.	2.	2.
2.	2.	2.	1.	1.	1.				

STAGE

49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0
49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.0
49.0	49.0	49.0	49.0	49.0	49.0	49.0	49.1	49.1	49.2
49.3	49.5	49.8	50.3	50.8	51.3	51.7	52.2	52.6	52.9
53.3	53.7	54.0	54.3	54.6	55.0	55.4	55.7	57.2	58.6
59.2	59.8	60.3	60.6	60.9	60.9	60.9	60.7	60.6	60.3
59.9	59.5	59.2	58.9	58.5	58.1	57.8	57.3	57.3	57.0
56.7	56.4	56.1	55.9	55.8	55.6	55.4	55.0	54.7	54.4
54.1	53.9	53.4	53.1	52.9	52.7	52.5	52.4	52.3	52.1
52.0	51.8	51.7	51.6	51.5	51.4				

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	4565.	2644.	781.	781.	74952.
CMS	129.	75.	22.	22.	2122.
INCHES		4.92	5.81	5.81	5.81
MM		124.93	147.50	147.50	147.50
AC-FT		1311.	1549.	1549.	1549.
THOUS CU M		1617.	1910.	1910.	1910.

MAXIMUM STORAGE = 41.

MAXIMUM STAGE IS 60.9

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                                   HYDROGRAPH ROUTING

                 CHANNEL ROUTING -MODIFIED PULS- STATION 3 TO 4

                       ISTAQ   ICOMP   IECON   ITAPE    JPLT    JPRT   INAME  ISTAGE   IAUTO
                           4       1       6       0       0       0       1       0       0
                                               ROUTING DATA
                 QLOSS   CLOSS     AVG    IRES   ISAME    IOPT    IPMP            LSTR
                   0.0   0.000    0.03       1       1       0       0               0

                       NSTPS   NSTDL     LAG   AMSKK       X     TSK   STORA  ISPRAT
                           0000000000       0   0.000   0.000   0.000      0.       0

NORMAL DEPTH CHANNEL ROUTING
----------------------------

     QN(1)   QN(2)   QN(3)   ELNVT   ELMAX   RLNTH     SEL
     .0566   .0453   .0500    46.0    80.0   4900.  .00100

     CROSS SECTION COORDINATES--STA,ELEV,STA,ELEV--ETC
        0.00   93.00  900.00   60.00 1100.00   49.00 1100.00   46.00 1125.00   46.00
     1125.00   49.00 1290.00   60.00 1900.00   80.00

STORAGE        0.00       5.93      13.62      24.42      40.06      63.94     129.67     186.03     233.31     342.09
             459.40     605.39     770.16     979.17    1200.09    1464.92    1749.60    2062.35    2402.93    2771.44

OUTFLOW        0.00      63.15     191.95     460.55     994.34    1491.18    3235.31    5103.02    7412.07   10004.08
           13856.83   19094.00   25874.88   34364.57   44725.86   57117.08   71691.69   88598.44  107981.75  129982.65

STAGE         46.03      47.79      49.58      51.37      53.16      54.95      56.74      58.53      60.32      62.11
              63.89      65.68      67.47      69.26      71.05      72.84      74.63      76.42      78.21      80.00

FLOW           0.00      63.15     191.95     460.55     994.34    1491.18    3235.31    5103.02    7412.07   10004.08
           13856.83   19094.00   25874.88   34364.57   44725.86   57117.08   71691.69   88598.44  107981.75  129982.65
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STATION 4, PLAN 1, RTIO 4

OUTFLOW

0.	0.	0.	0.	0.	0.	0.	0.	0.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	2.	2.
3.	6.	9.	16.	25.	38.	55.	82.	116.	148.
190.	210.	240.	272.	307.	348.	395.	451.	607.	965.
1525.	2174.	2730.	3271.	3790.	4154.	4290.	4311.	4215.	4035.
3772.	3442.	3090.	2757.	2444.	2163.	1910.	1706.	1516.	1345.
1194.	1063.	953.	863.	783.	711.	647.	588.	533.	482.
437.	396.	356.	319.	286.	259.	236.	217.	200.	184.
170.	157.	146.	135.	126.	119.				

STOR

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	1.	1.	2.	3.	4.	6.	7.	9.
10.	12.	13.	15.	17.	19.	21.	24.	31.	48.
70.	92.	112.	131.	147.	157.	162.	162.	159.	154.
146.	134.	125.	113.	103.	93.	85.	77.	69.	63.
57.	52.	47.	43.	39.	36.	33.	30.	28.	25.
23.	21.	19.	17.	15.	14.	13.	12.	11.	10.
10.	9.	9.	8.	8.	7.				

STAGE

46.0	46.0	46.0	46.0	46.0	46.0	46.0	46.0	46.0	46.0
46.0	46.0	46.0	46.0	46.0	46.0	46.0	46.0	46.0	46.0
46.0	46.0	46.0	46.0	46.0	46.0	46.0	46.0	46.0	46.1
46.1	46.2	46.3	46.4	46.7	47.1	47.6	48.0	48.5	49.0
49.4	49.7	49.9	50.1	50.3	50.6	50.9	51.3	51.9	53.1
54.2	55.3	56.1	56.8	57.3	57.6	57.8	57.0	57.7	57.5
57.3	56.4	56.5	56.1	55.7	55.3	55.0	54.6	54.2	52.9
53.6	53.3	53.0	52.7	52.4	52.2	52.0	51.8	51.6	51.4
51.2	50.9	50.7	50.4	50.2	50.0	49.9	49.7	49.6	49.5
49.3	49.1	48.9	48.8	48.7	48.6				

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	4331.	2613.	777.	777.	74591.
CMS	122.	74.	22.	22.	2112.
INCHES		4.86	5.78	5.78	5.78
MM		123.49	146.87	146.87	146.87
AC-FT		1296.	1541.	1541.	1541.
THOUS CU M		1598.	1901.	1901.	1901.

MAXIMUM STORAGE = 162.

MAXIMUM STAGE IS 57.0

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```
                              HYDROGRAPH ROUTING

              CHANNEL ROUTING -MODIFIED PULS- STATION 4 TO 5

                      ISTAQ   ICOMP   IECON   ITAPE    JPLT    JPRT   INAME  ISTAGE   IAUTO
                          5       1       0       0       0       0       1       0       0
                                                ROUTING DATA
              QLOSS   CLOSS     AVG    IRES   ISAME    IOPT    IPMP            LSTR
                0.0   0.000    0.00       1       1       0       0               0

                      NSTPS   NSTOL     LAG   AMSKK       X     TSK   STORA  ISPRAT
                          0100000000      0   0.000   0.000   0.000      0.       0
```

NORMAL DEPTH CHANNEL ROUTING

```
       QN(1)   QN(2)   QN(3)   ELNVT   ELMAX   RLNTH     SEL
       .0900   .0450   .0900    40.0    80.0   8700.  .00100

       CROSS SECTION COORDINATES--STA,ELEV,STA,ELEV--ETC
          0.00   90.00 1803.00   60.00 2360.00   43.00 2300.00   40.00 2325.00   40.00
       2325.00   43.00 2900.00   60.00 4360.00   80.00

STORAGE       0.00      10.51      37.16     152.63     365.73     676.46    1084.93    1590.83    2194.46    2895.73
           3645.70    4609.42    5612.17    6729.74    7953.94    9263.96   10719.01   12262.26   13910.07   15665.09

OUTFLOW       0.00      81.60     303.40    1209.67    3759.12    8267.77   15300.21   25297.00   38667.51   55797.32
          76890.20  102610.59  133477.43  169770.22  211024.82  259936.00  314430.29  379622.07  443824.29  519339.92

STAGE        40.00      42.11      44.21      46.32      48.42      50.53      52.63      54.74      56.84      58.95
             61.05      63.16      65.26      67.37      69.47      71.58      73.68      75.79      77.89      80.00

FLOW          0.00      81.60     303.40    1209.67    3759.12    8267.77   15300.21   25297.00   38667.51   55797.32
          76890.25  102610.59  133477.43  169770.22  211024.82  259936.00  314430.29  379622.07  443824.29  519339.92
```

STATION 5, PLAN 1, RTIO 3

OUTFLOW

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	1.
1.	1.	1.	2.	3.	4.	6.	9.	12.	17.
22.	29.	38.	49.	61.	74.	90.	108.	127.	140.
175.	210.	269.	382.	576.	820.	1390.	1375.	1649.	1827.
1915.	1932.	1890.	1827.	1733.	1623.	1506.	1389.	1279.	1194.
1129.	1026.	946.	869.	797.	731.	669.	612.	559.	511.
466.	425.	386.	351.	316.	288.	262.	238.	216.	197.
179.	164.	150.	137.	126.	116.				

STOR

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	1.	1.	1.	2.	2.
3.	4.	5.	6.	8.	10.	12.	14.	16.	19.
22.	26.	33.	46.	68.	96.	130.	160.	184.	198.
207.	208.	205.	199.	191.	181.	171.	161.	151.	141.
132.	122.	112.	103.	95.	87.	80.	73.	67.	61.
56.	51.	47.	43.	39.	35.	32.	29.	27.	24.
22.	20.	19.	17.	16.	15.				

STAGE

40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0
40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0
40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0
40.0	40.0	40.0	40.0	40.1	40.1	40.2	40.2	40.3	40.4
40.6	40.8	41.0	41.3	41.6	41.9	42.2	42.4	42.5	42.7
43.0	43.3	43.9	44.4	44.8	45.3	45.9	46.4	46.6	46.8
46.8	46.9	46.8	46.8	46.7	46.6	46.5	46.4	46.3	46.1
45.9	45.8	45.6	45.4	45.3	45.1	45.0	44.9	44.8	44.7
44.6	44.5	44.4	44.3	44.2	44.1	43.8	43.6	43.4	43.2
43.0	42.9	42.8	42.6	42.5	42.4				

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	1932.	1266.	388.	388.	37284.
CMS	55.	36.	11.	11.	1055.
INCHES		2.36	2.89	2.89	2.89
MM		59.83	73.37	73.37	73.37
AC-FT		628.	770.	770.	770.
THOUS CU M		774.	950.	950.	950.

MAXIMUM STORAGE = 208.

MAXIMUM STAGE IS 46.9

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STATION 5, PLAN 1, RTIO 4

OUTFLOW

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	2.	3.	4.	7.	10.	16.	23.	35.	49.
66.	86.	100.	131.	156.	183.	213.	246.	291.	371.
513.	725.	1001.	1337.	1807.	2270.	2688.	3033.	3295.	3472.
3565.	3574.	3506.	3393.	3215.	3020.	2810.	2596.	2385.	2181.
1986.	1803.	1633.	1470.	1338.	1230.	1141.	1056.	976.	900.
828.	762.	699.	641.	586.	535.	488.	446.	407.	372.
341.	312.	286.	263.	242.	223.				

STOR

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	1.	1.	1.	2.	3.	4.	6.
9.	11.	14.	16.	19.	23.	26.	30.	36.	45.
62.	87.	119.	157.	197.	237.	273.	303.	326.	341.
349.	350.	344.	333.	319.	302.	284.	265.	247.	230.
213.	197.	182.	169.	157.	146.	135.	125.	116.	107.
99.	91.	83.	77.	70.	64.	59.	54.	49.	45.
42.	39.	35.	32.	30.	28.				

STAGE

40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0
40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0
40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0
40.0	40.0	40.1	40.1	40.2	40.3	40.4	40.6	40.9	41.3
41.7	42.1	42.4	42.6	42.8	43.1	43.4	43.7	44.1	44.4
44.7	45.1	45.7	46.4	46.8	47.2	47.5	47.8	48.0	48.2
48.3	48.3	48.2	48.1	48.0	47.8	47.6	47.4	47.2	47.1
46.9	46.8	46.6	46.5	46.4	46.2	46.0	45.8	45.6	45.5
45.3	45.2	45.1	44.9	44.8	44.7	44.6	44.5	44.4	44.4
44.3	44.2	44.0	43.8	43.6	43.4				

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	3574.	2445.	763.	763.	73258.
CMS	101.	69.	22.	22.	2074.
INCHES		4.55	5.68	5.68	5.68
MM		115.54	144.24	144.24	144.24
AC-FT		1212.	1514.	1514.	1514.
THOUS CU M		1495.	1867.	1867.	1867.

MAXIMUM STORAGE = 350.

MAXIMUM STAGE IS 48.3

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PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
AREA IN SQUARE MILES (SQUARE KILOMETERS)

Breach

				RATIOS APPLIED TO FLOWS			
OPERATION	STATION	AREA	PLAN	RATIO 1 .10	RATIO 2 .25	RATIO 3 .50	RATIO 4 1.00
HYDROGRAPH AT	1	5.00 (12.95)	1	435. (12.32)(	1088. (30.80)(	2175. (61.60)(	4351. (123.20)(
ROUTED TO	2	5.00 (12.95)	1	373. (10.55)(	2087. (59.10)(	3066. (86.82)(	4578. (129.63)(
ROUTED TO	3	5.00 (12.95)	1	372. (10.54)(	2058. (58.27)(	3065. (86.80)(	4505. (127.50)(
ROUTED TO	4	5.00 (12.95)	1	344. (9.74)(	1692. (47.92)(	2717. (76.93)(	4301. (121.80)(
ROUTED TO	5	5.00 (12.95)	1	275. (7.78)(	1081. (30.61)(	1932. (54.71)(	3574. (101.19)(

SUMMARY OF DAM SAFETY ANALYSIS

Breach

PLAN 1 ....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	56.50	56.5C	59.50
STORAGE	40.	40.	88.
OUTFLOW	0.	0.	616.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.10	57.94	0.00	75.	373.	0.00	15.00	0.00
.25	59.70	.20	93.	2106.	.46	14.98	13.75
.50	59.70	.20	95.	32C7.	.56	13.96	13.00
1.00	59.50	.00	90.	4657.	.42	13.83	12.00

PLAN 1 STATION 3

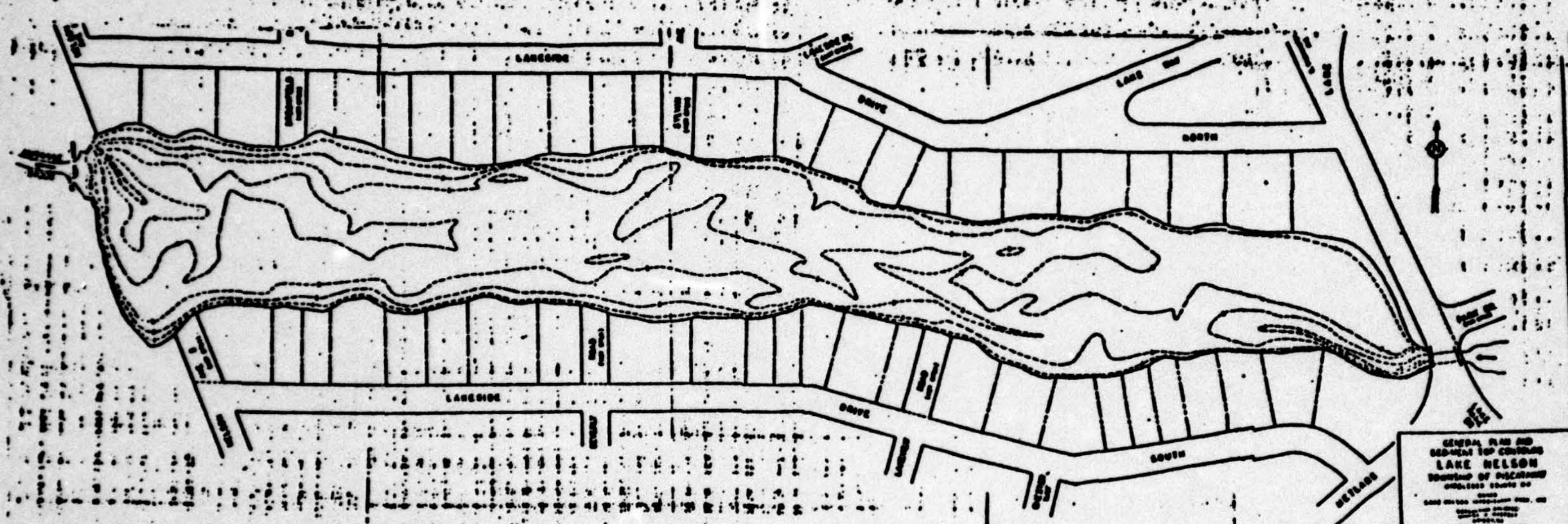
RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.10	372.	56.6	15.00
.25	2050.	59.7	14.50
.50	3065.	59.7	14.60
1.00	4505.	60.9	14.00

PLAN 1 STATION 4

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.10	344.	50.6	15.50
.25	1692.	54.6	15.00
.50	2717.	56.3	14.56
1.00	4301.	57.6	14.50

PLAN 1 STATION 5

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.10	279.	43.9	16.75
.25	1081.	45.9	16.00
.50	1932.	46.9	15.50
1.00	2574.	48.3	15.56



REF. LAKE NELSON ENVIRONMENTAL
PROTECTION AND IMPROVEMENT
AUG. 1971 HAEFELI, CONSULTING
ENGINEERS

Dam application no 97 One
3/2/27

Drainage Area 5.0 sq mi

Spillway 81' × 3" c = 2.64

$$\frac{13.7 \times 81}{5} = 222.\text{ sec ft/sq mi OK.}$$

Cut off. OK

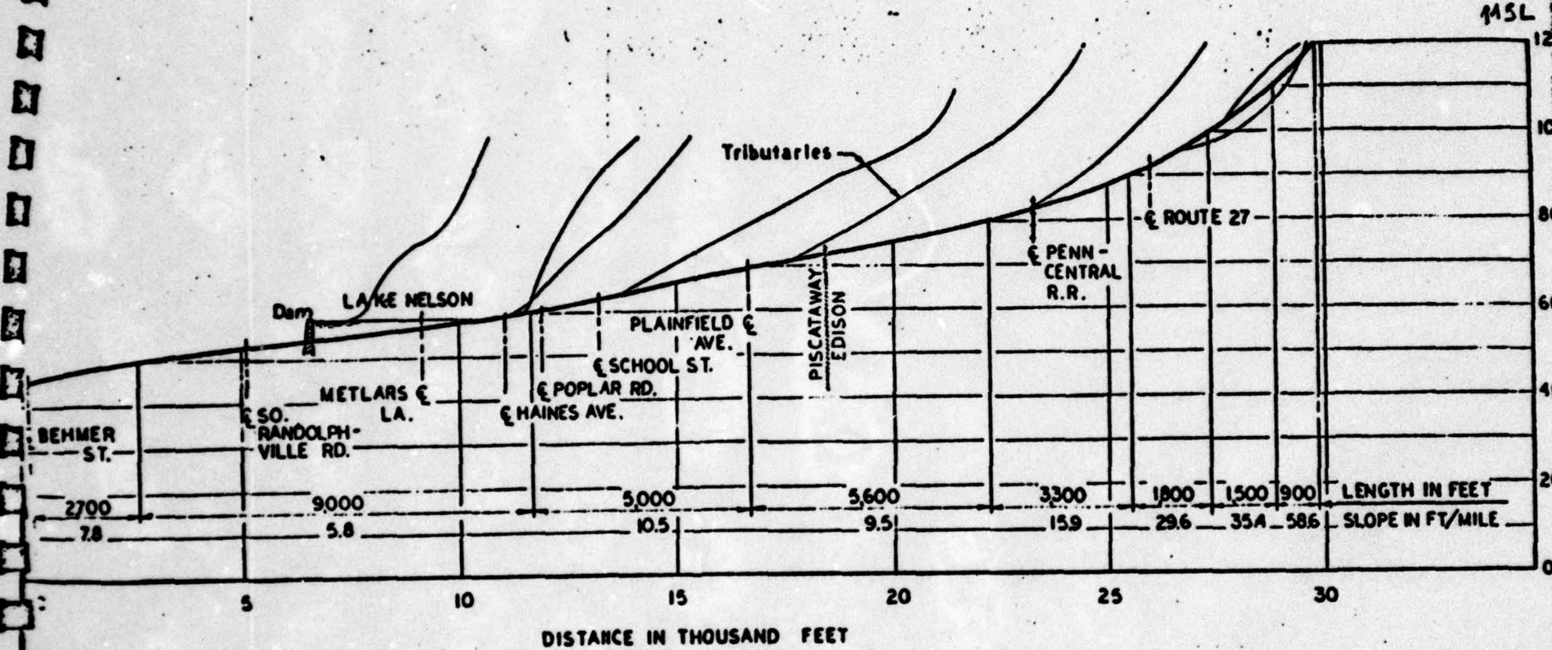
Slopes see letter of 3/2/27

$$Q = \frac{81 \times 2.64 \times 3^{3/2}}{5}\ \ 5.2 \quad = 222$$

$$= 1111.14 \text{ C.F.S.}$$

REF. STATE FILES

FIGURE 2



AMBROSE BROOK PROFILE

REF. LAKE NELSON ENVIRONMENTAL PROTECTION AND IMPROVEMENT AUG. 1971 HAEFELI, CONSULTING ENGINEERS

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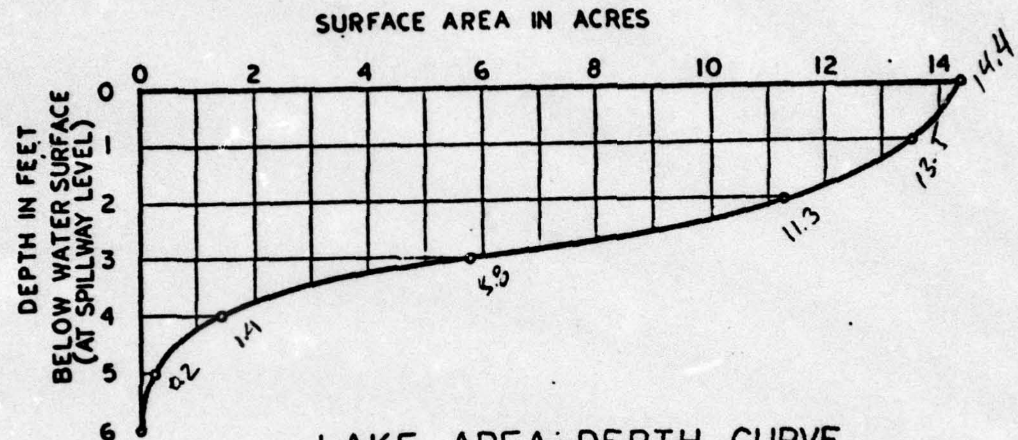
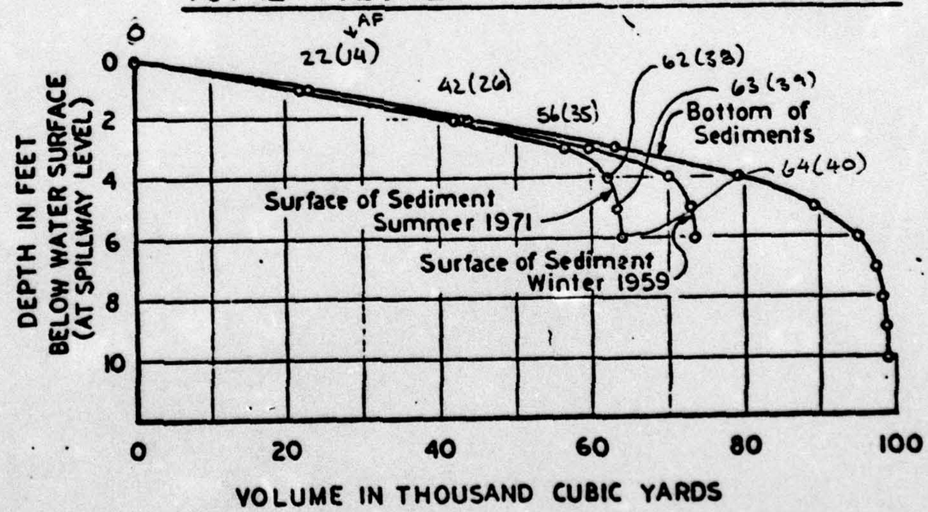
LAKE NELSON

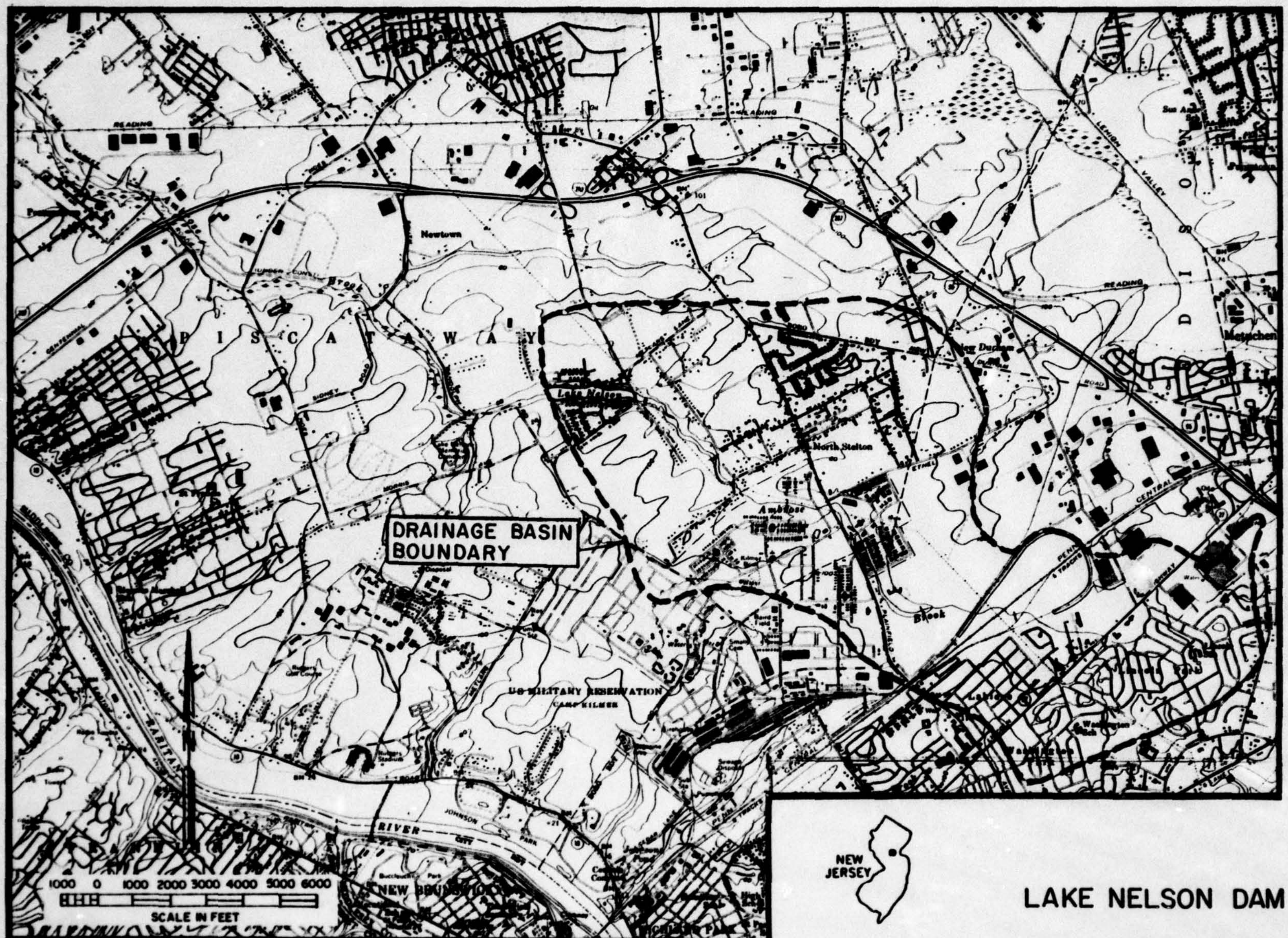


LAKE AREA-DEPTH CURVE

TOTAL VOLUMES FROM WATER SURFACE



ROBERT J. HAEFELI, P
CONSULTING ENGINEE
1996 STATE HIGHWAY
EDISON, N. J. 08817



AREA LOCATION

LAKE NELSON DAM

JENNY - LEEDSHILL JANUARY 1979

PLATE D-1

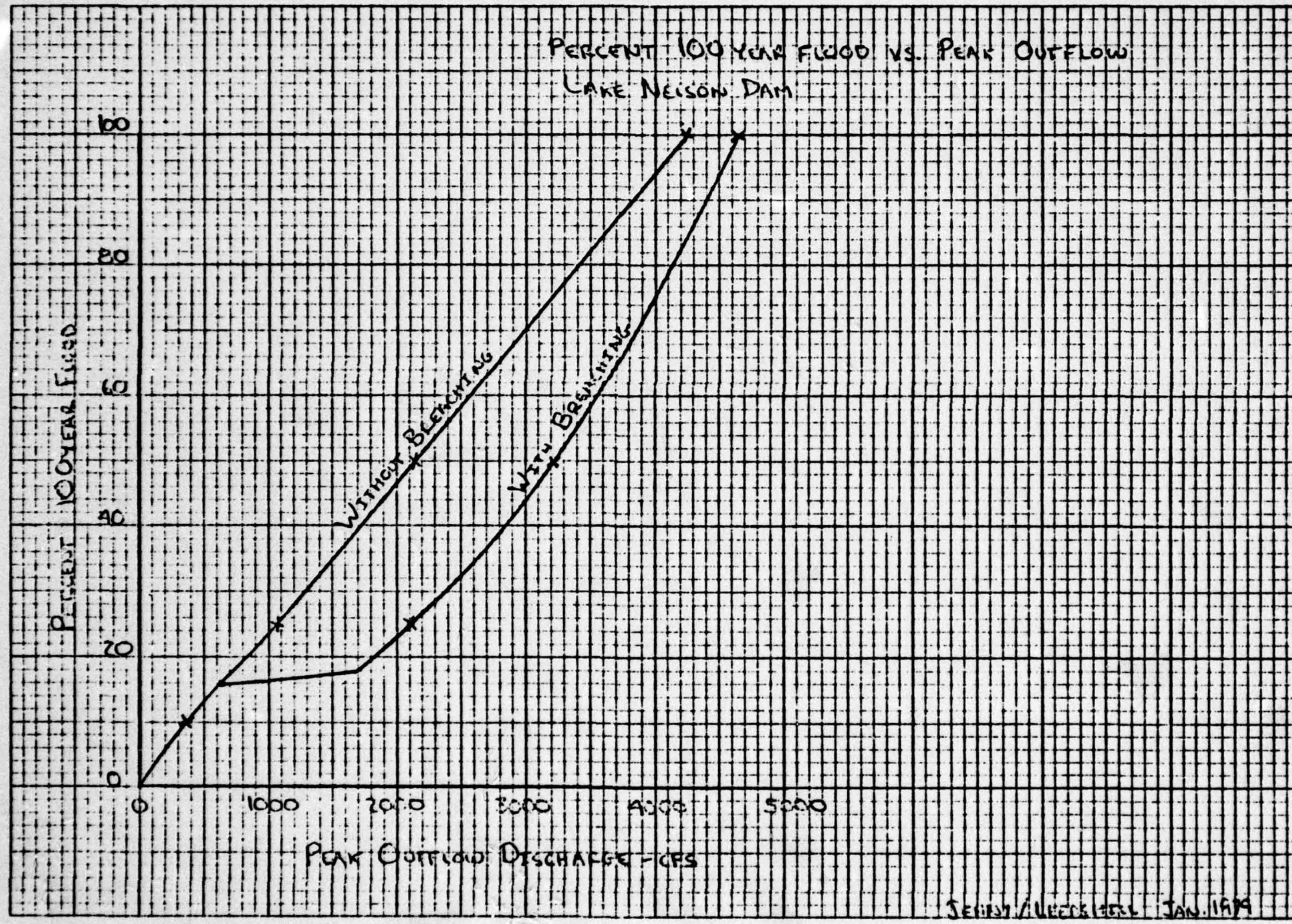
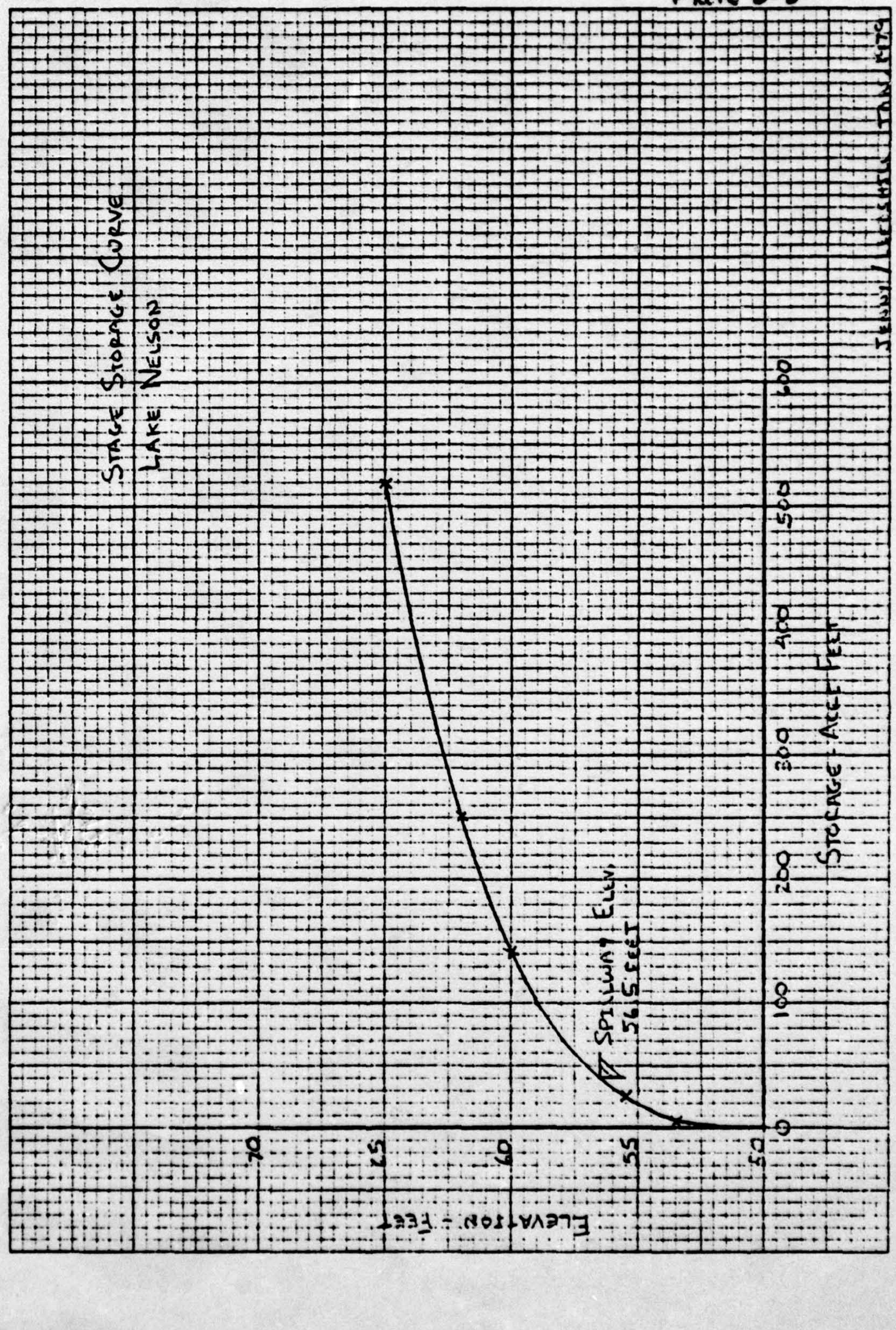

PERCENT 100 YEAR FLOOD VS. PEAK OUTFLOW
LAKE NELSON DAM
PERCENT 100 YEAR FLOOD
PEAK OUTFLOW DISCHARGE - CFS
WITHOUT BREACHING
WITH BREACHING
0
20
40
60
80
100
1000
2000
3000
4000
5000

Plate D-2

Plate D-3



STAGE STORAGE CURVE
LAKE NELSON
SPILLWAY ELEV. 56.5 FEET
ELEVATION - FEET
50
55
60
65
70
STORAGE - ACRE FEET
0
100
200
300
400
500
600

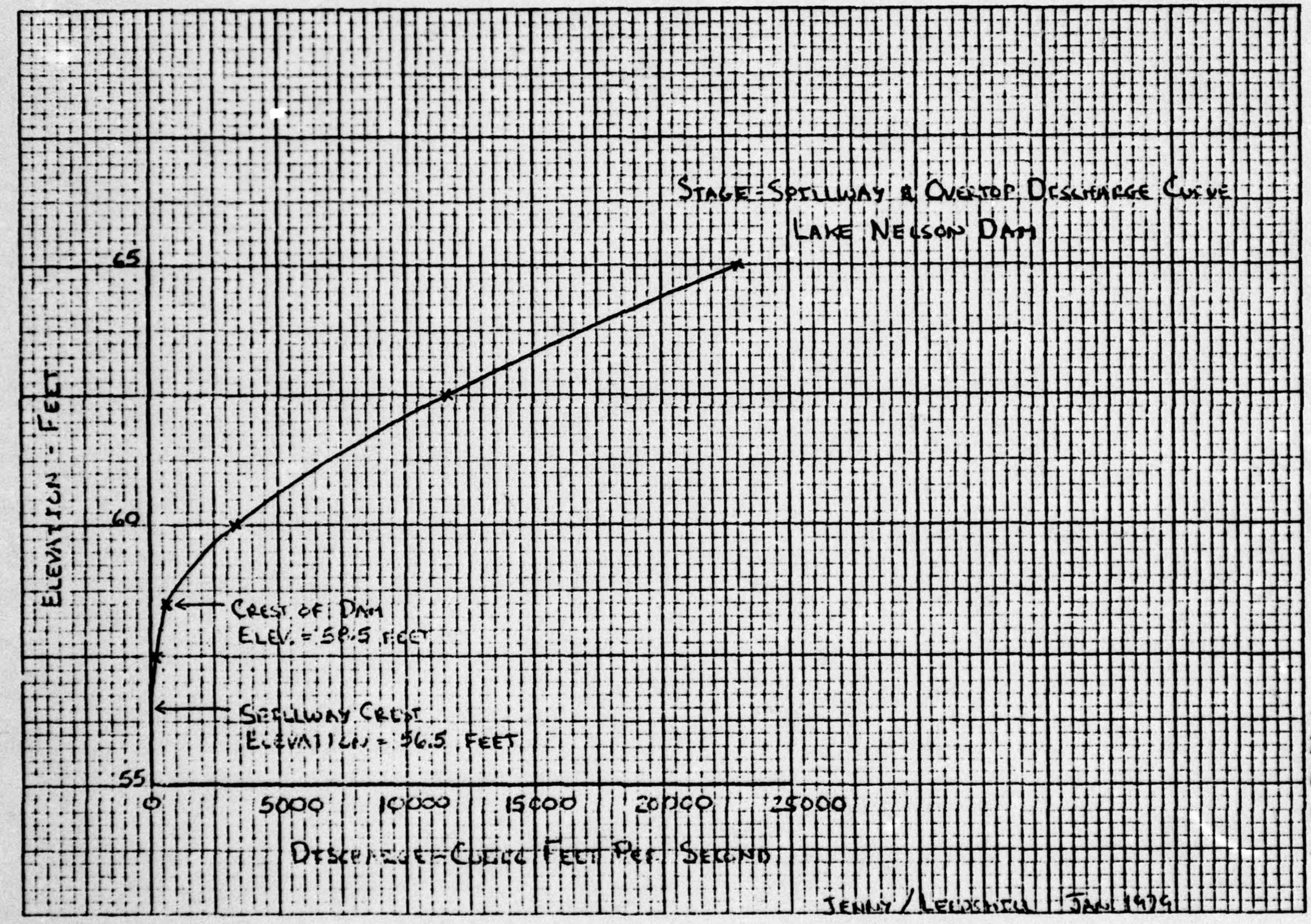

STAGE-SPILLWAY & OVERTOP DISCHARGE CURVE
LAKE NELSON DAM
ELEVATION - FEET
65
60
55
CREST OF DAM
ELEV. = 58.5 FEET
SPILLWAY CREST
ELEVATION = 56.5 FEET
0
5000
10000
15000
20000
25000
DISCHARGE - CUBIC FEET PER SECOND

Plate D-4